United States Patent [19]

Antepenko

[11] **3,952,961**

[45] **Apr. 27, 1976**

[54] **STRAP DISPENSING METHOD AND APPARATUS**

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[73] Assignee: **Signode Corporation,** Glenview, Ill.

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[21] Appl. No.: **449,924**

[52] **U.S. Cl.** ..... **242/54 R;** 242/78.6; 242/105

[51] **Int. Cl.²** **B65H 75/32; B65H 17/52**

[58] **Field of Search** ..... 242/54 R, 67.4, 77, 242/105, 78.6

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Attorney, Agent, or Firm—Dressler, Goldsmith, Clement & Gordon, Ltd.

[57] **ABSTRACT**

A strap dispenser is mounted for vertical movement on a frame from an elevated rest position to a strap dispensing position therebelow. The dispenser includes a coil of strap that is clamped by a hub, and upon demand for strap, the hub is permitted to fall from the rest position to transform the potential energy of the strap coil to rotational energy through a one-way clutch, which overcomes the inertia of the strap coil and initiates its rotation. When the demand for strap ceases, a mechanism is actuated in response thereto for positively holding the hub against rotation with respect to the shaft, and the inertia of the formerly rotating coil is utilized to return the hub mechanism to a rest position.

34 Claims, 20 Drawing Figures

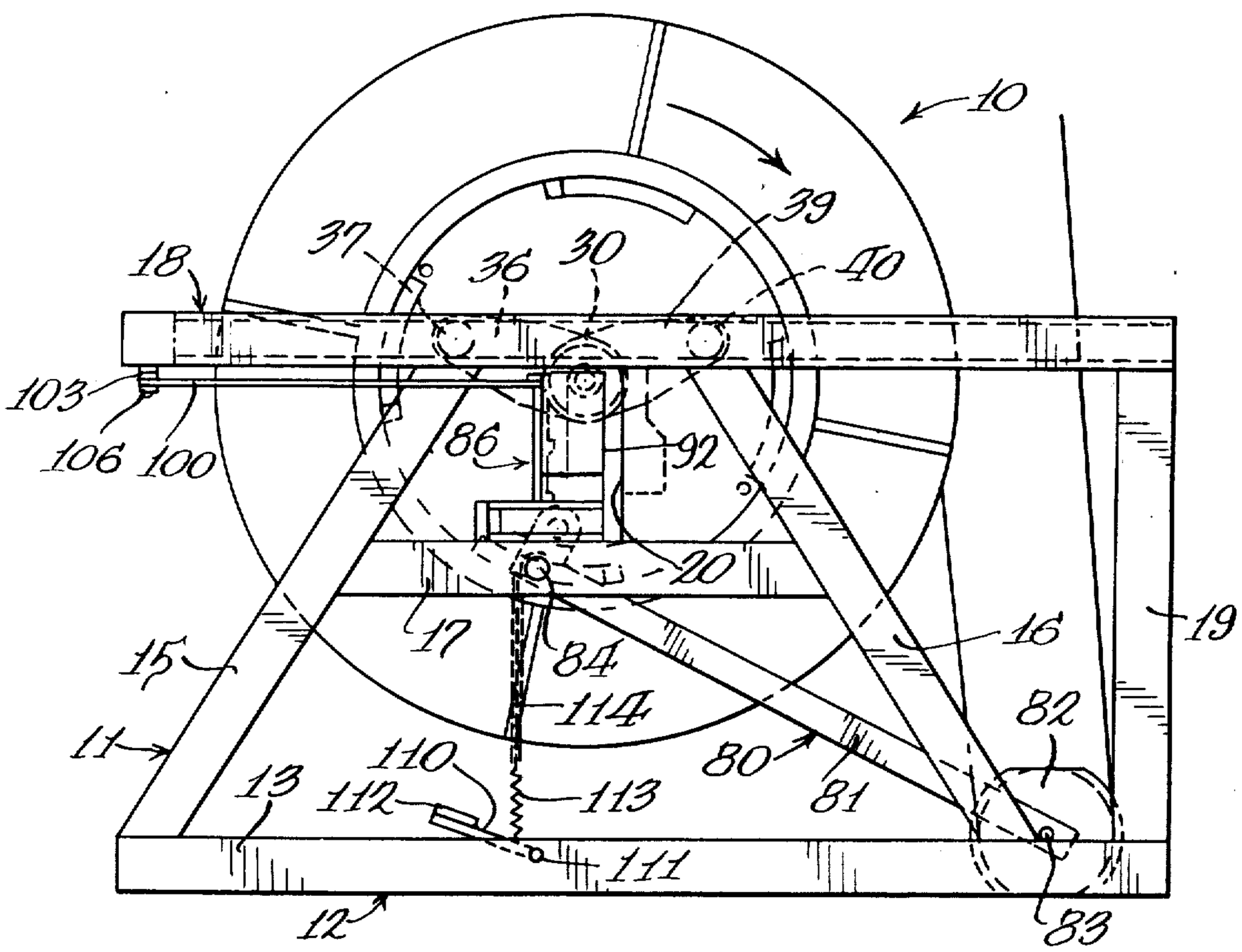

Fig. 1.

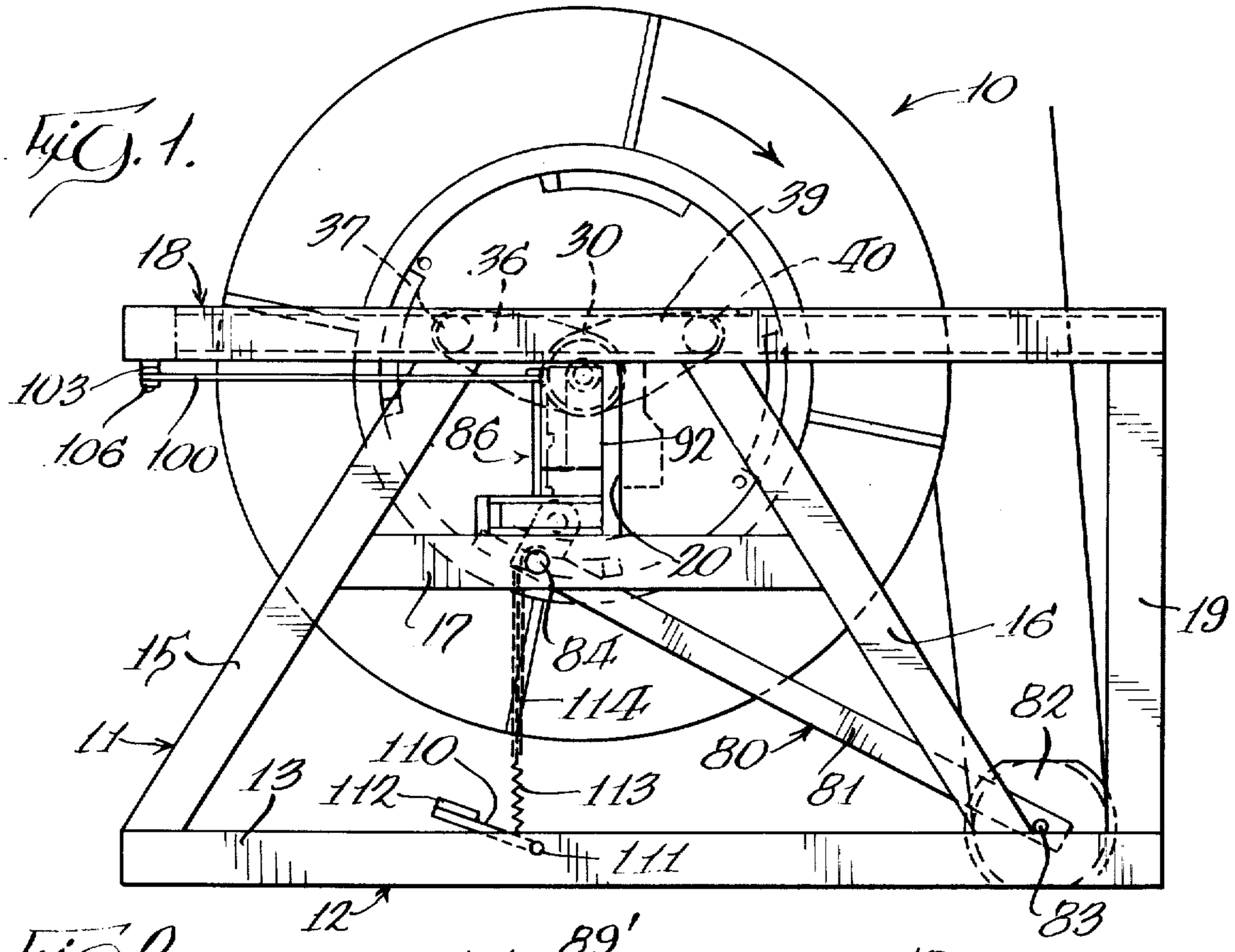

Fig. 2.

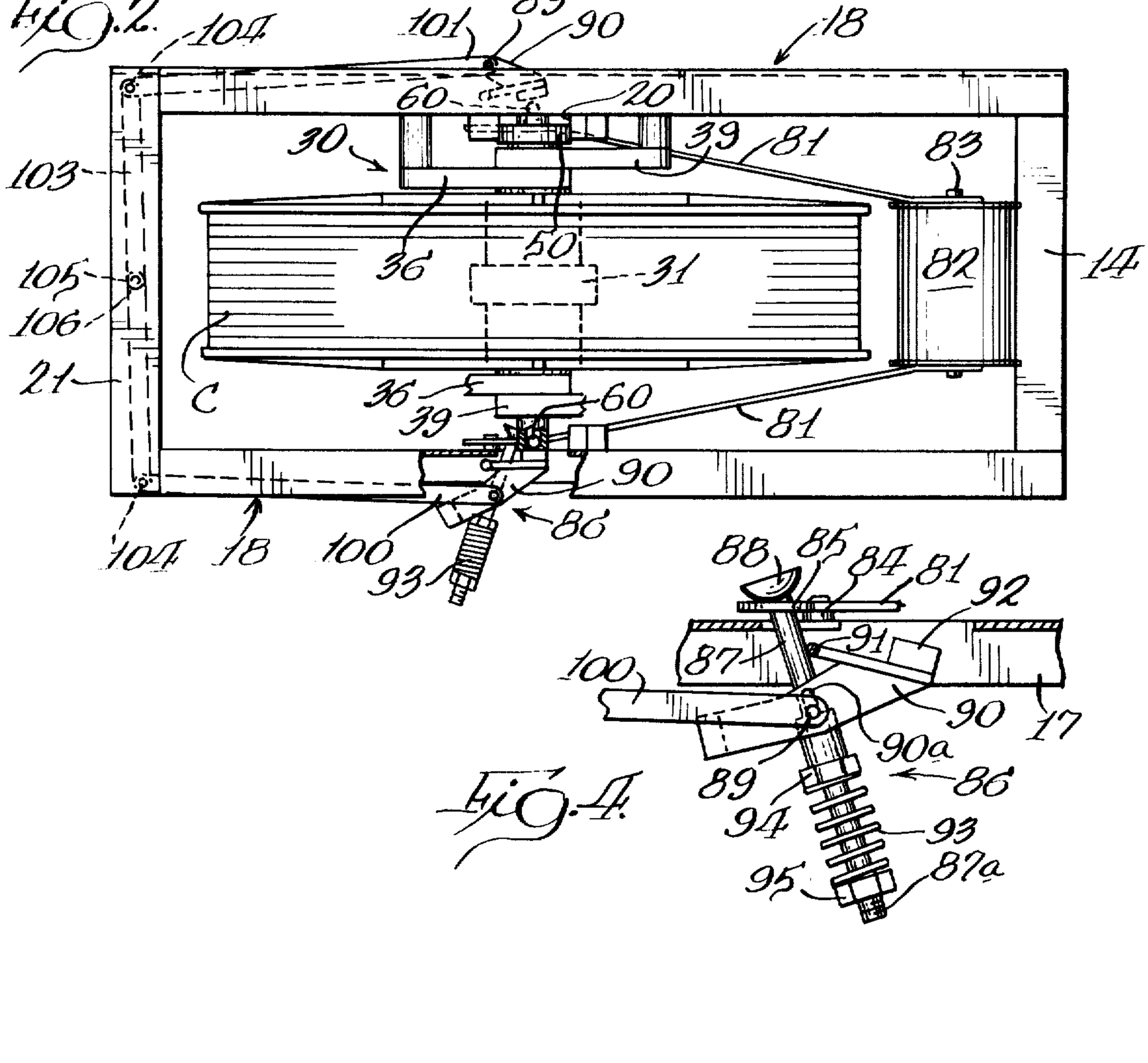

Fig. 4.

Fig. 3.

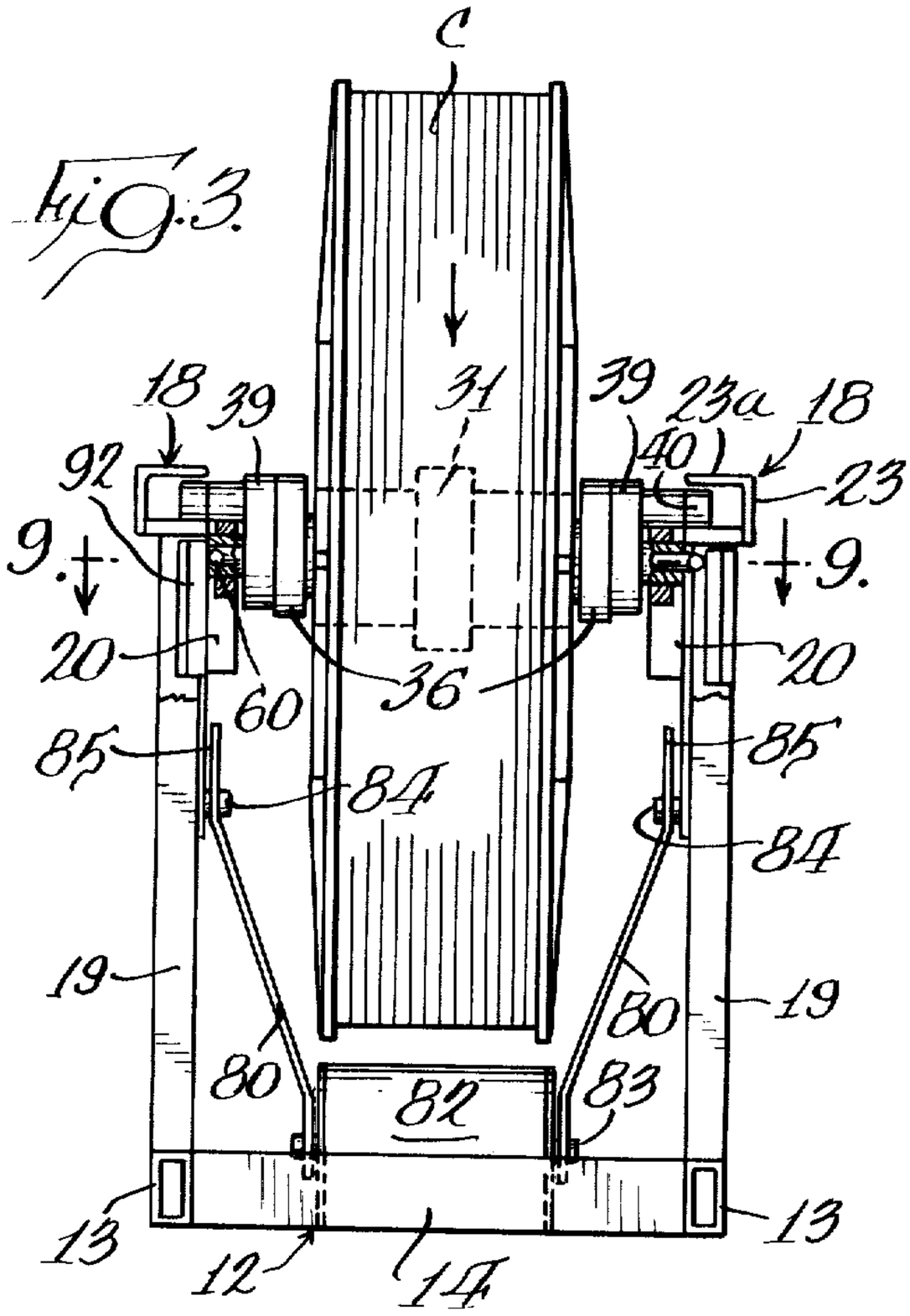

Fig. 5.

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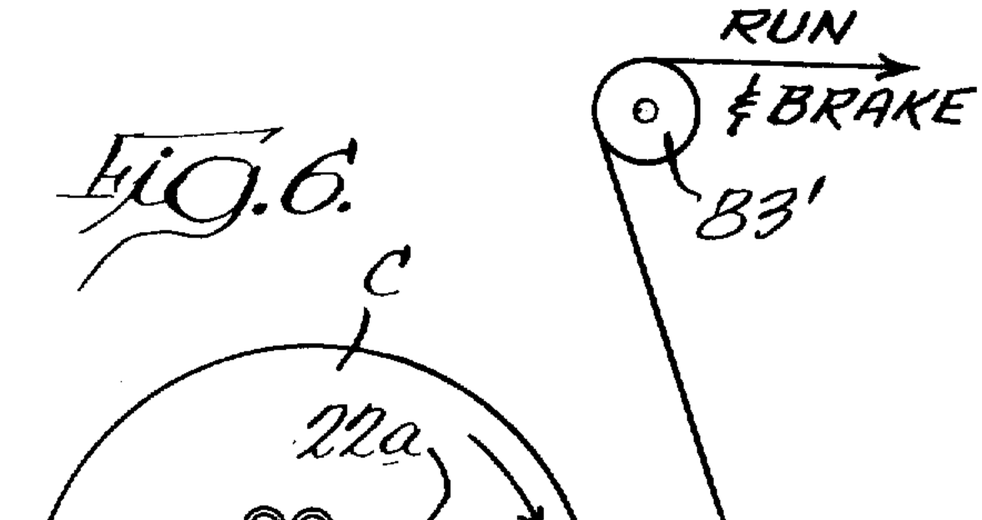

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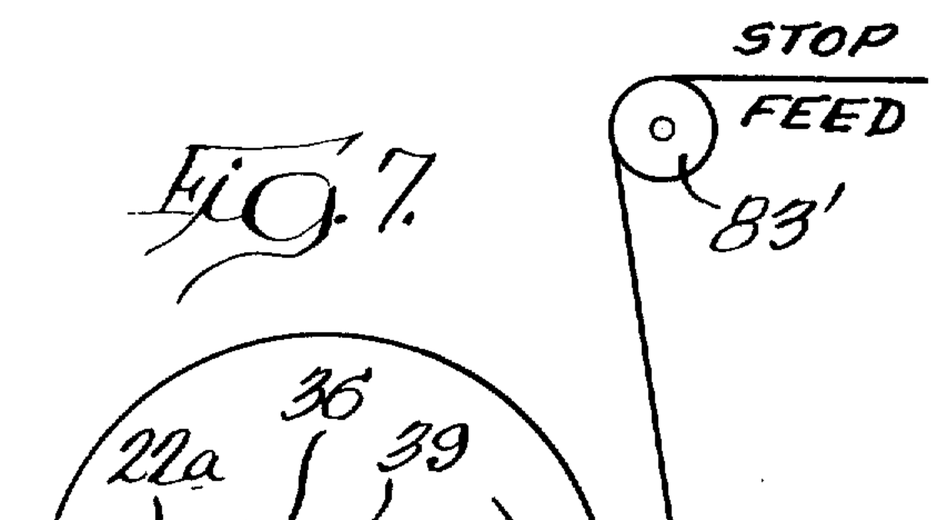


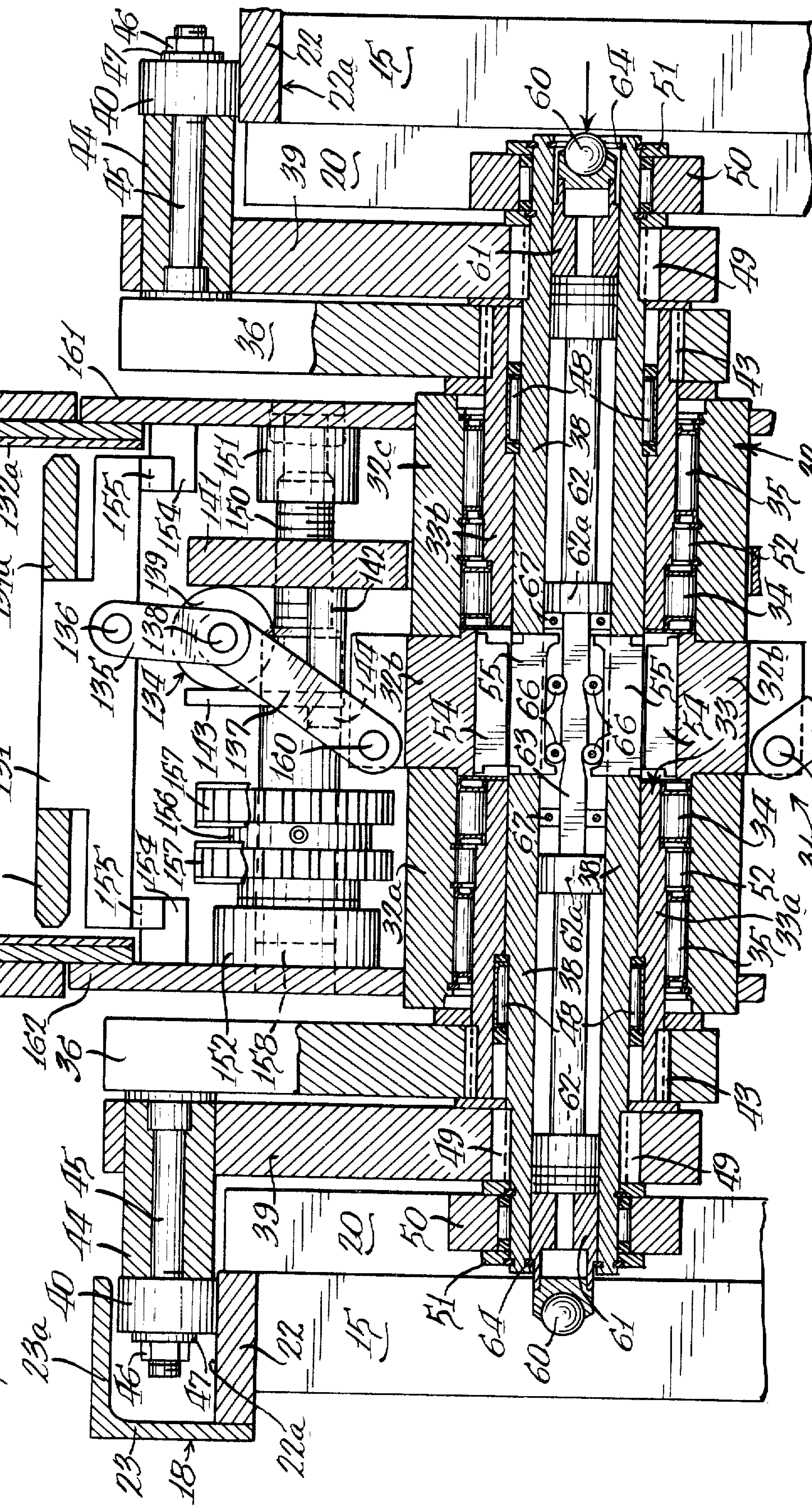


FIG. 8

Fig. 9.

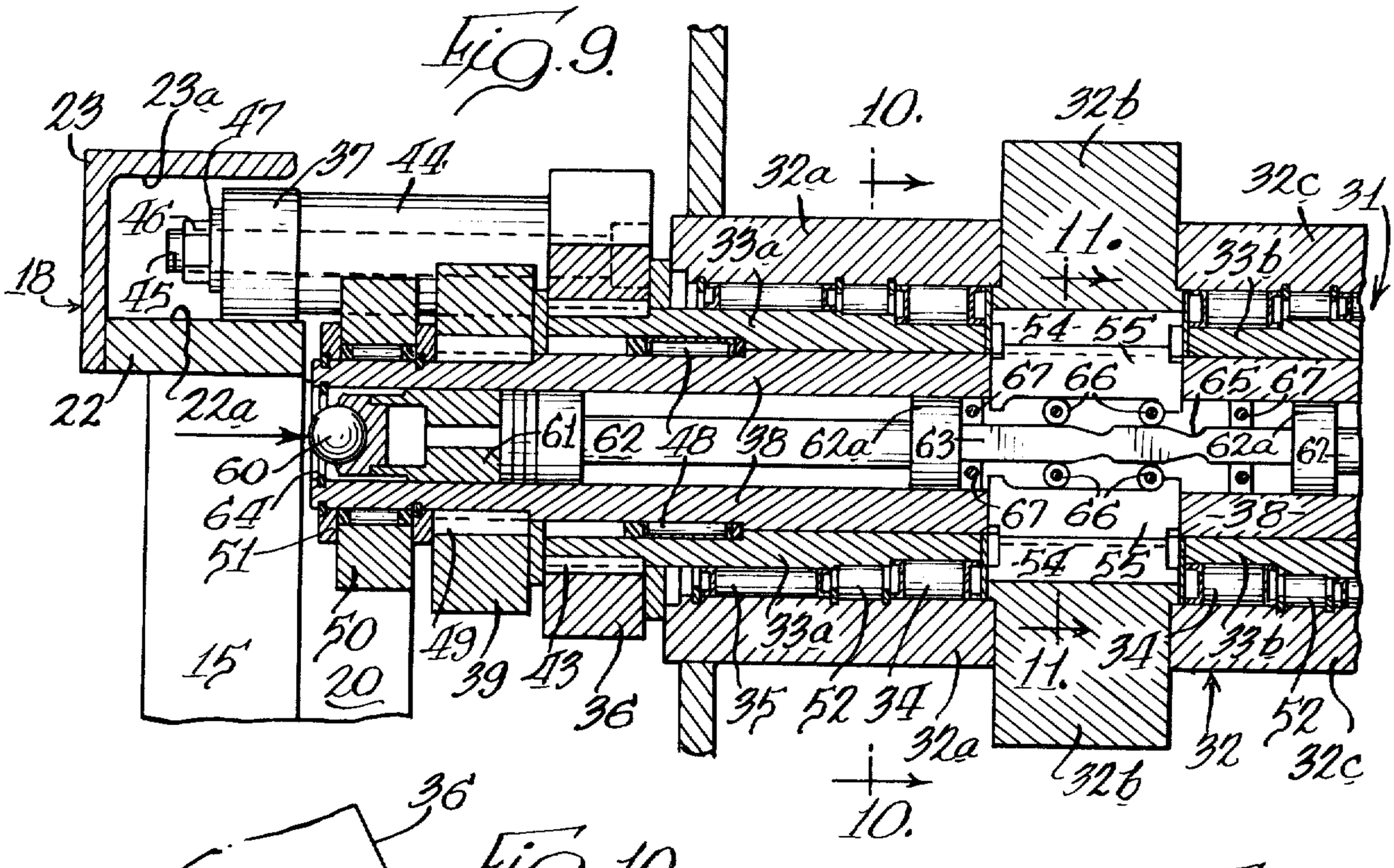


Fig. 10.

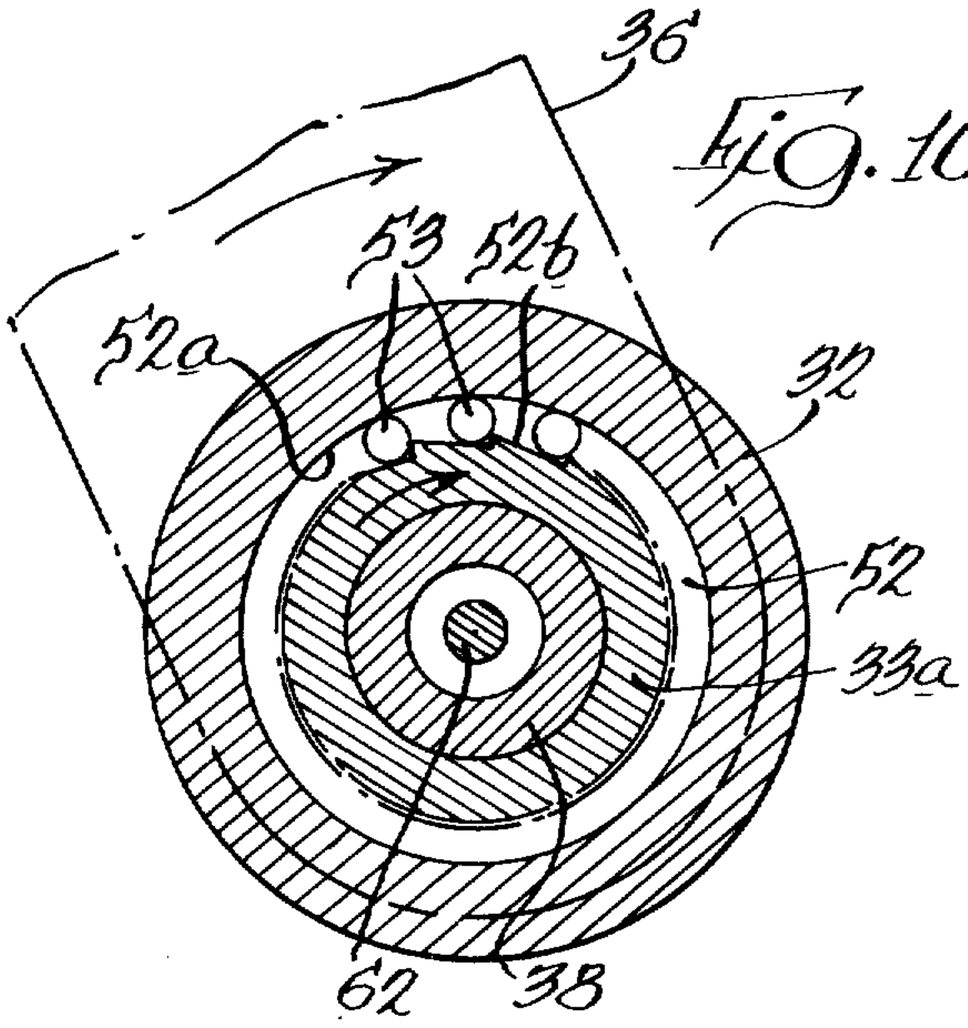
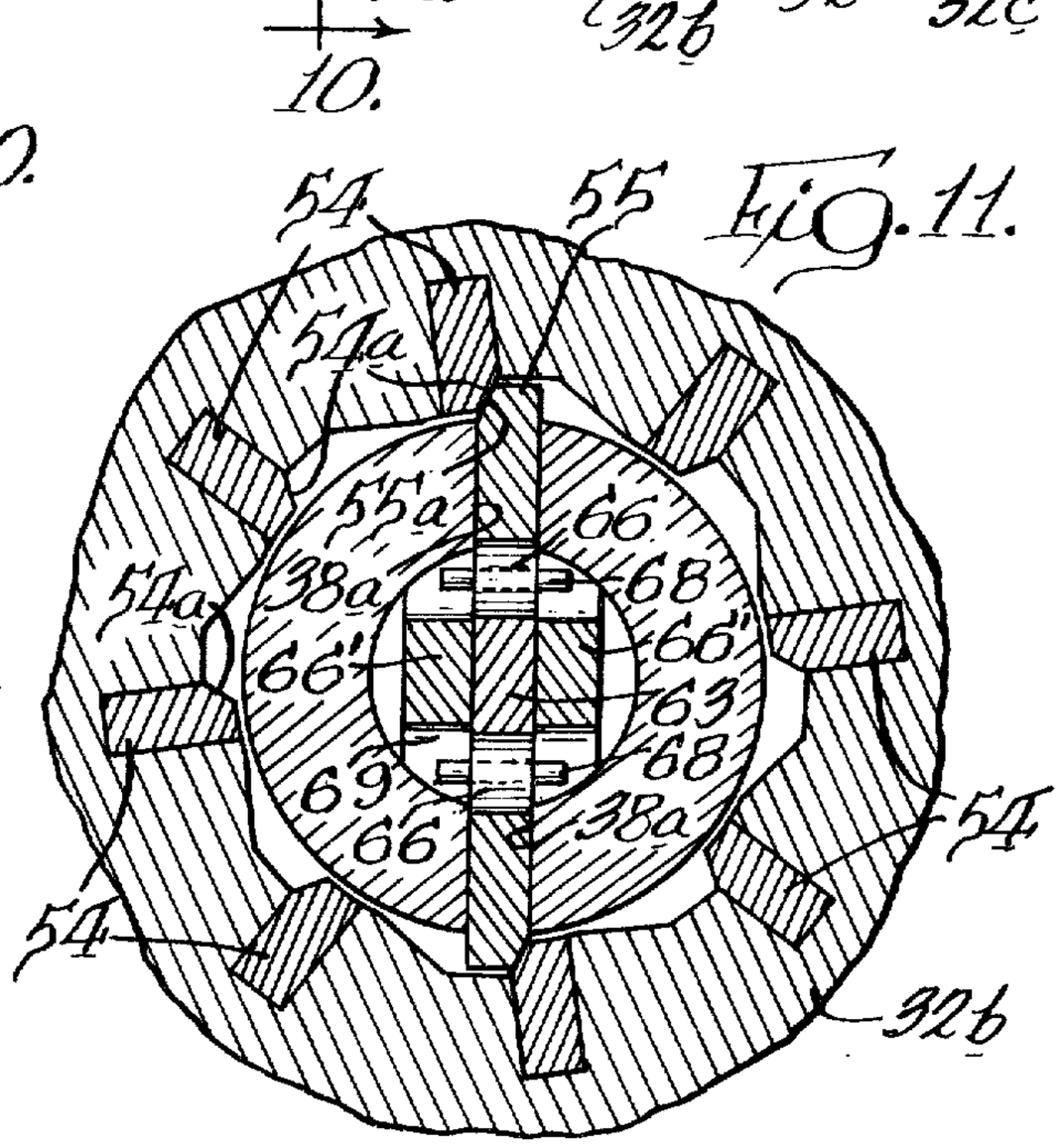


Fig. 11.



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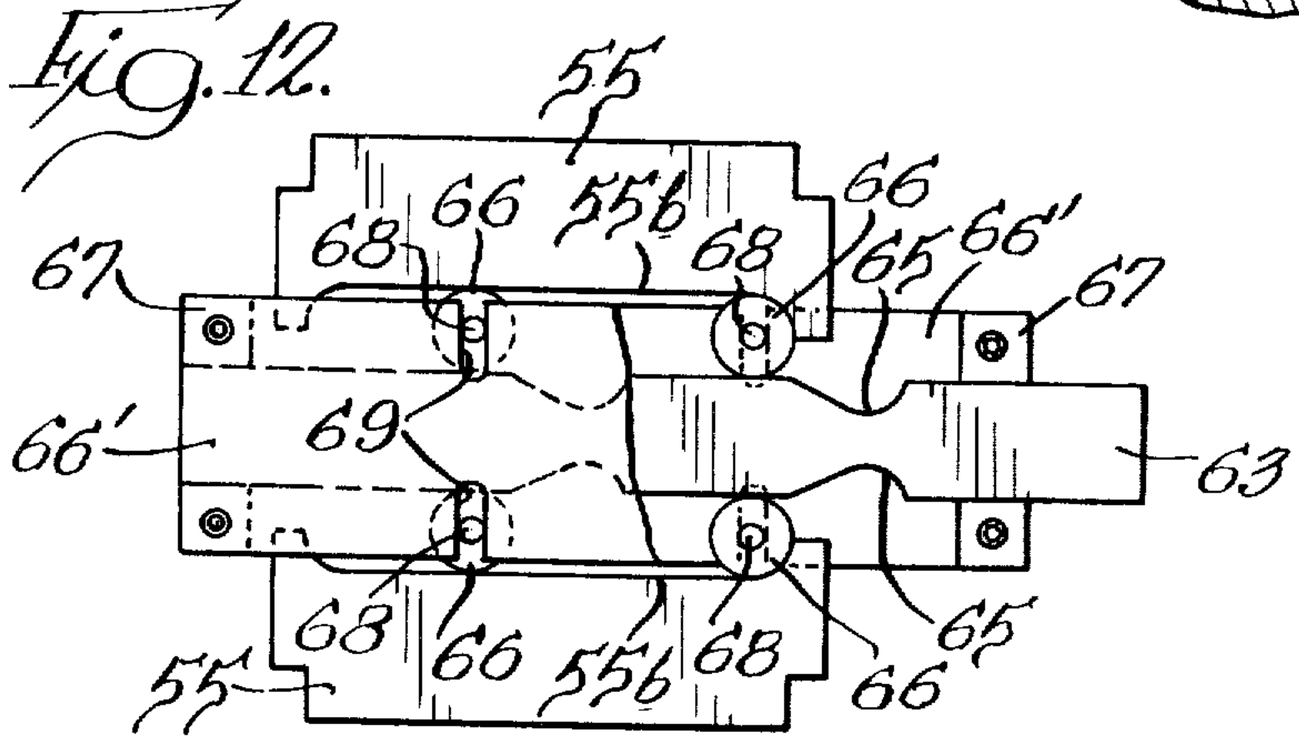

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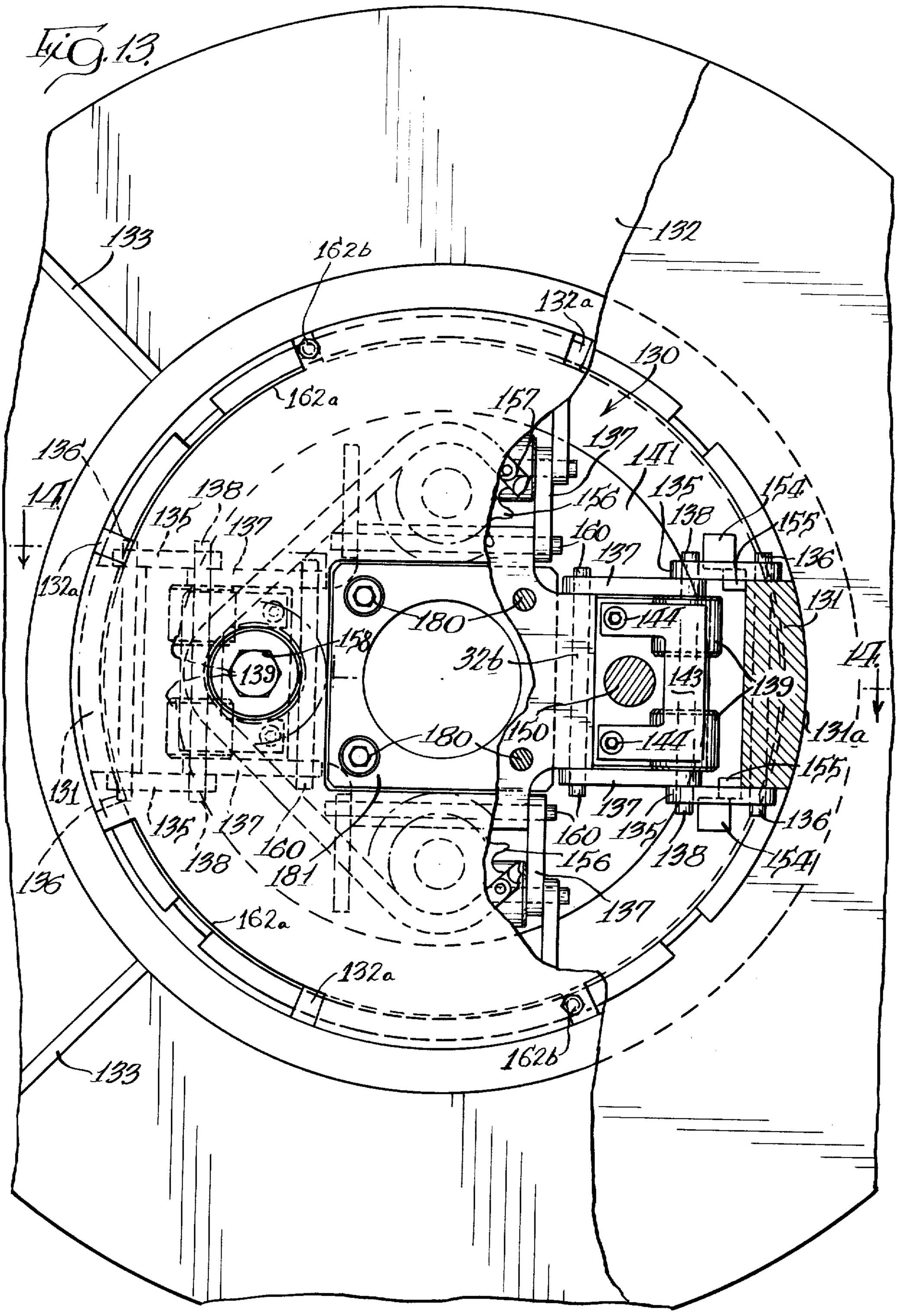
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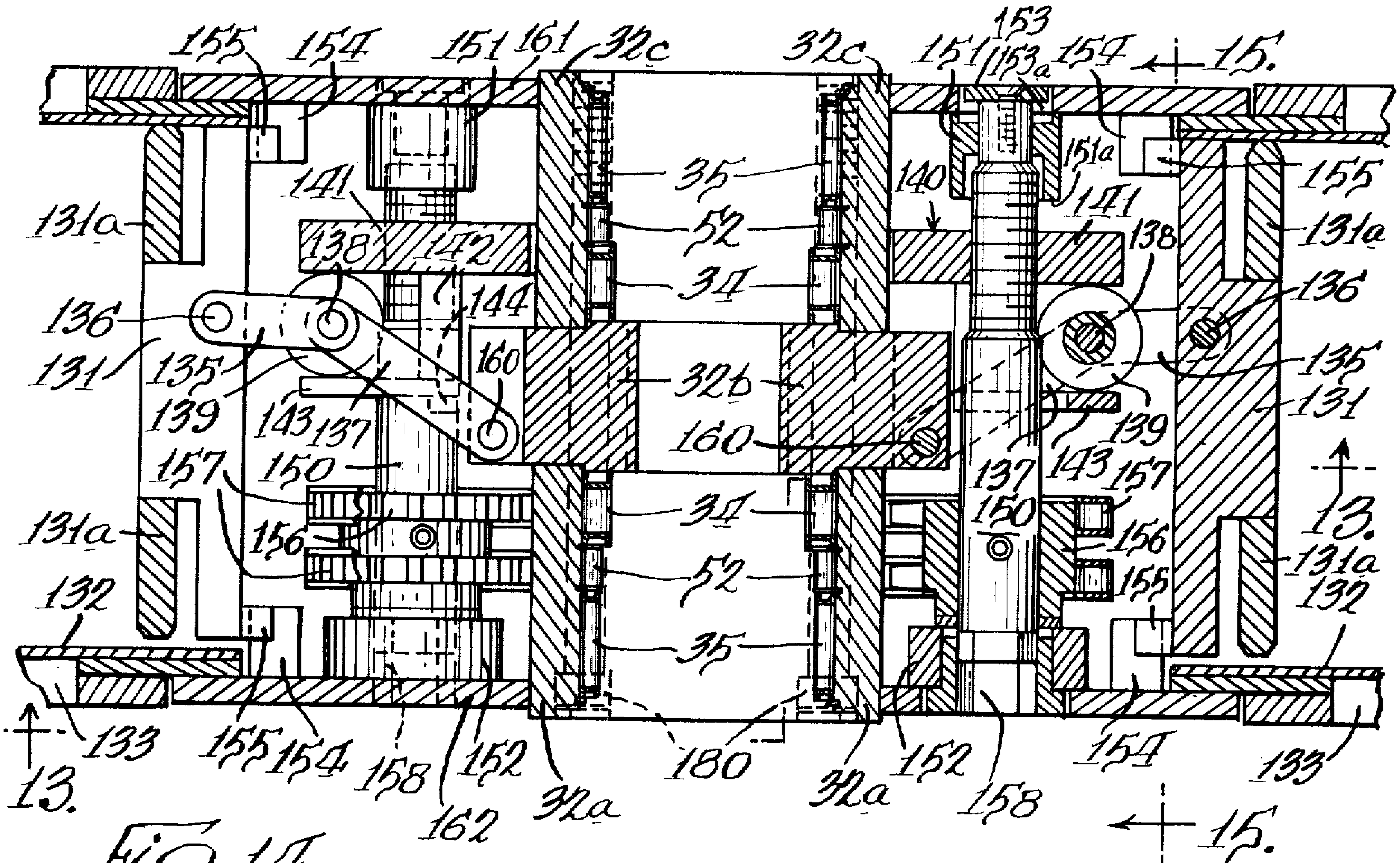
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Fig.14.

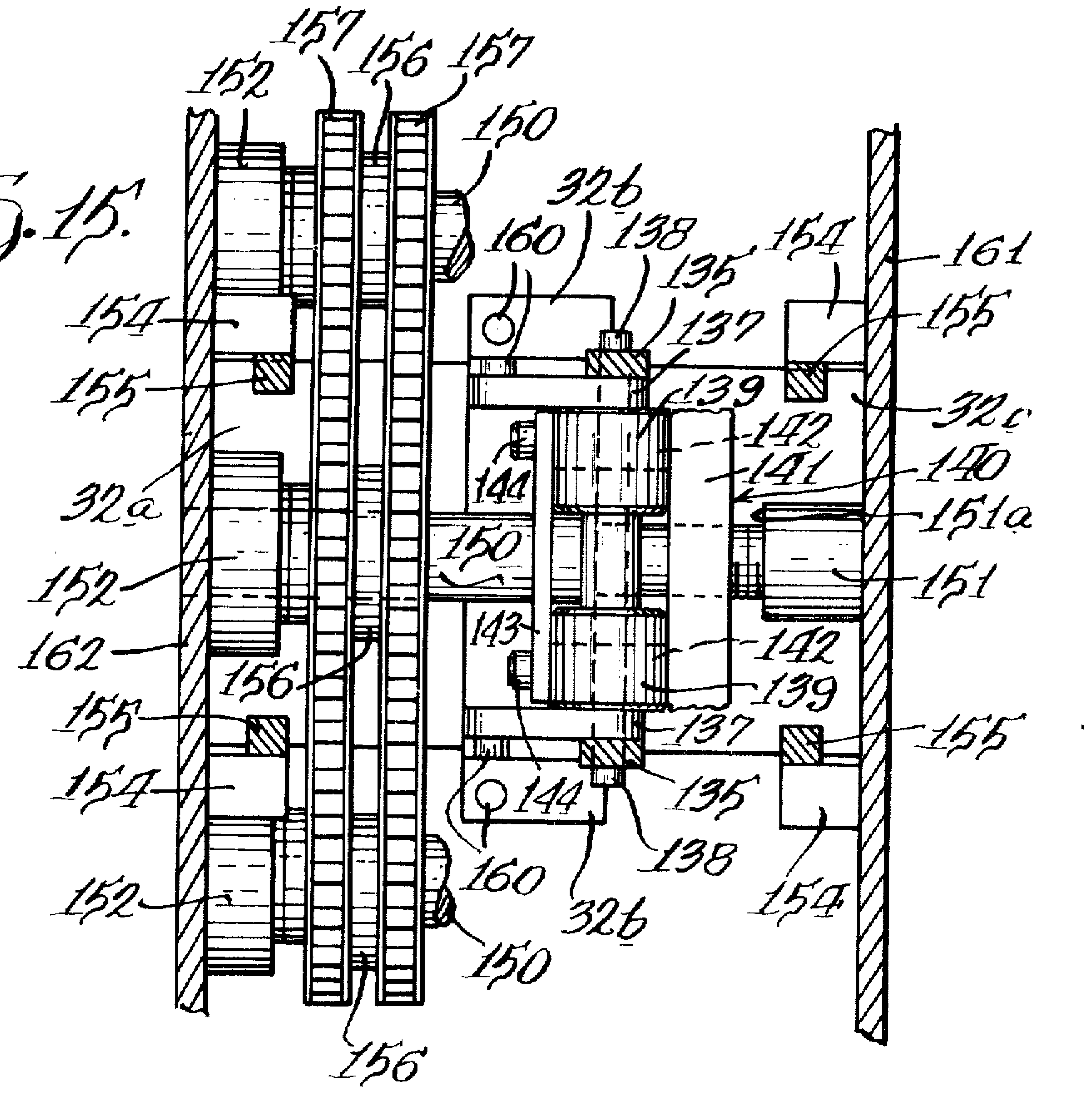
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Fig.15.

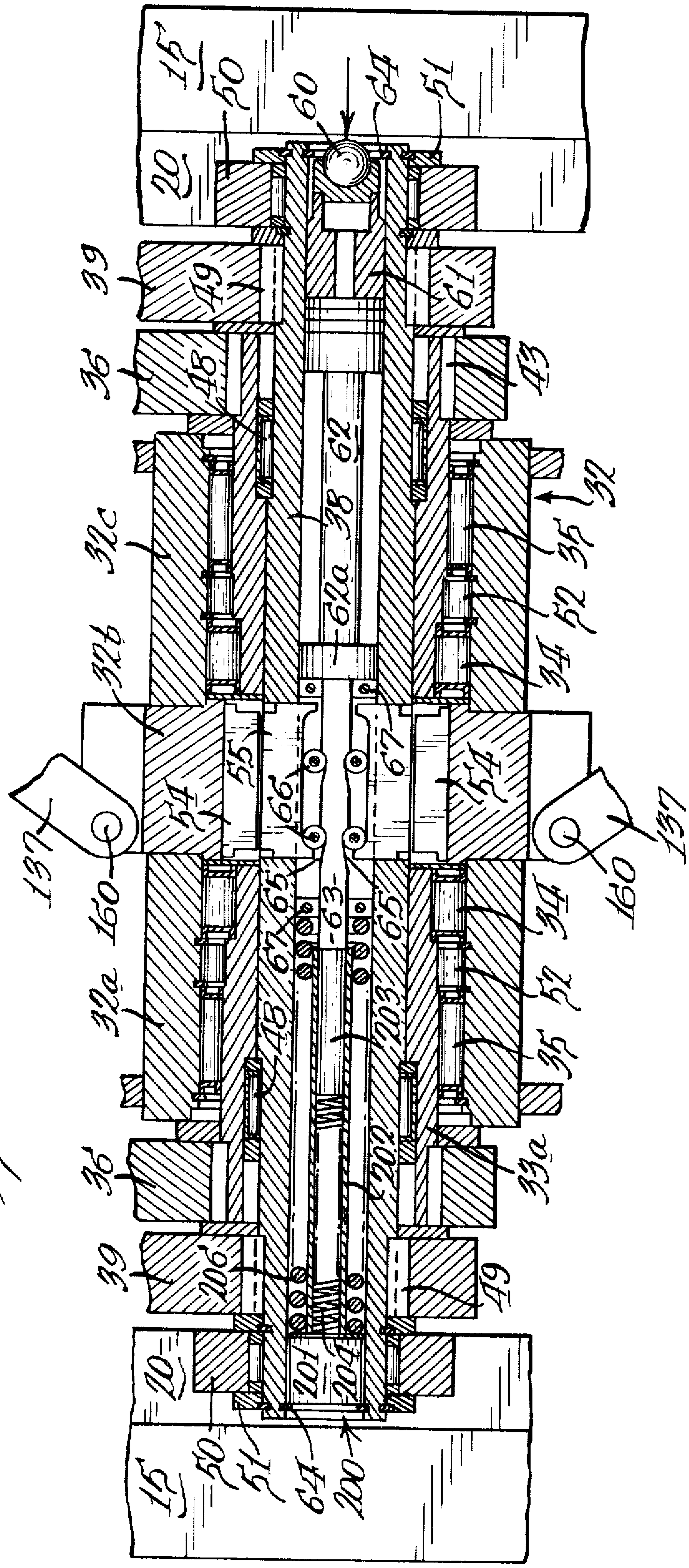
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Fig. 16.

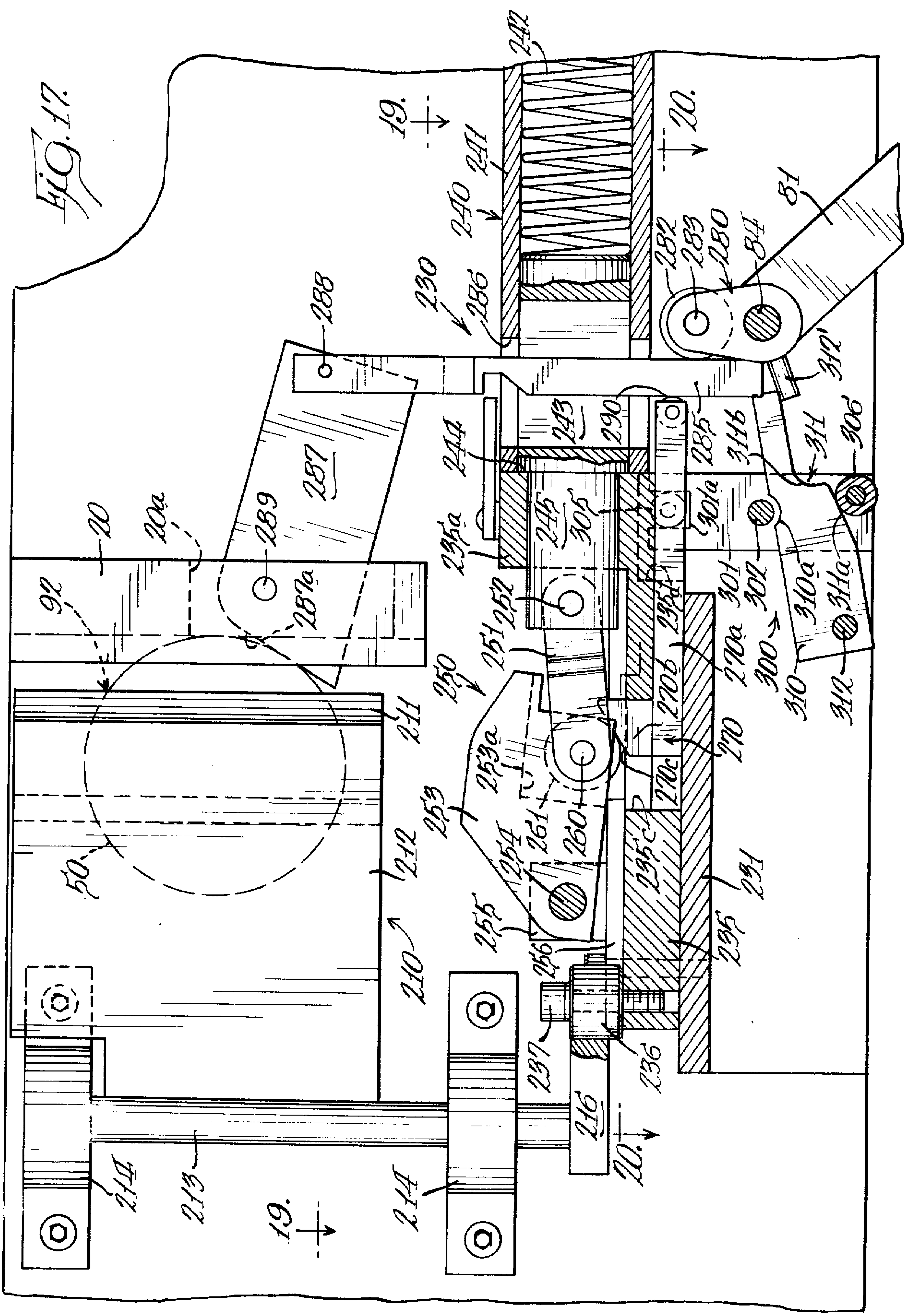
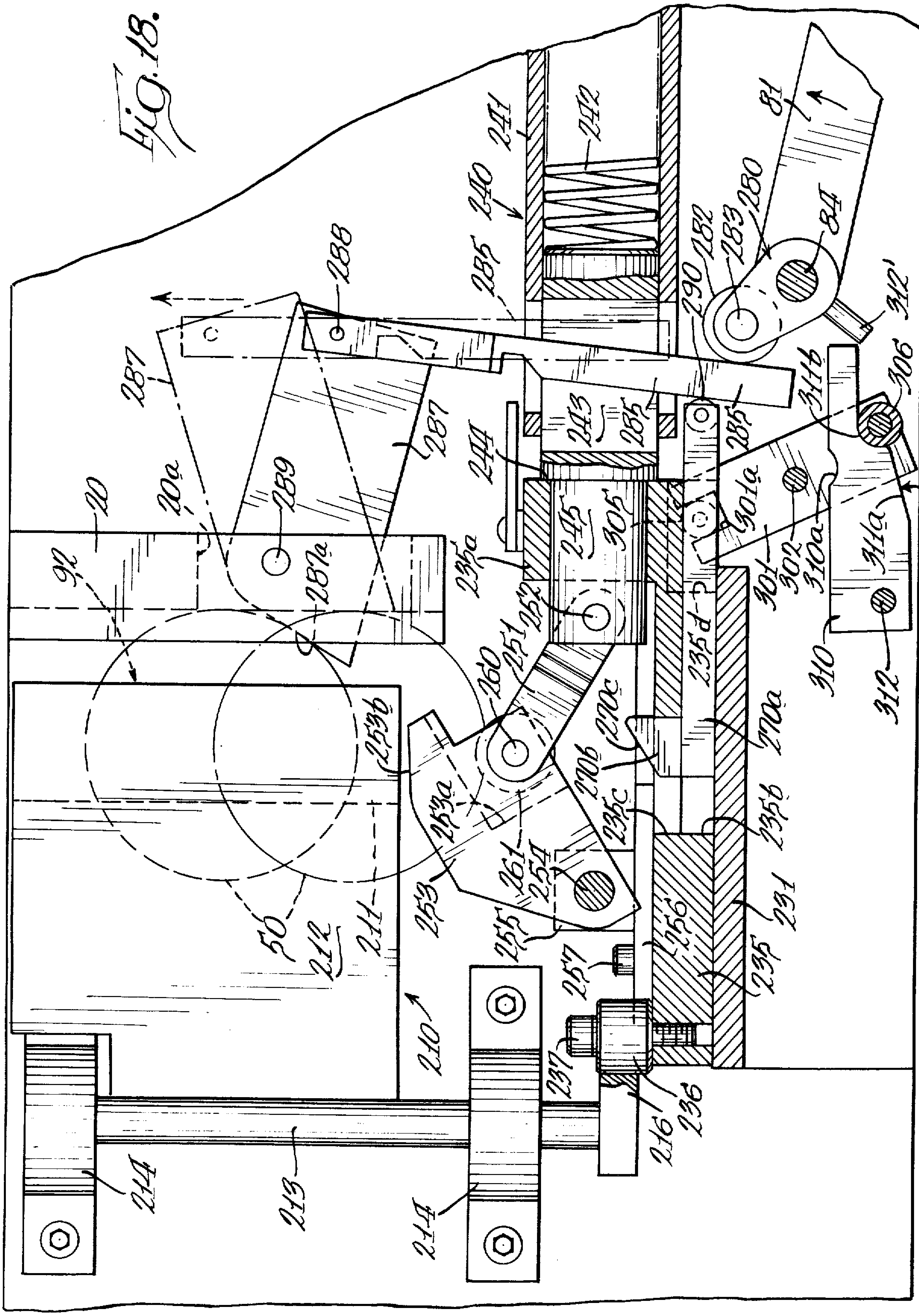


FIG. 17.

Fig. 18.



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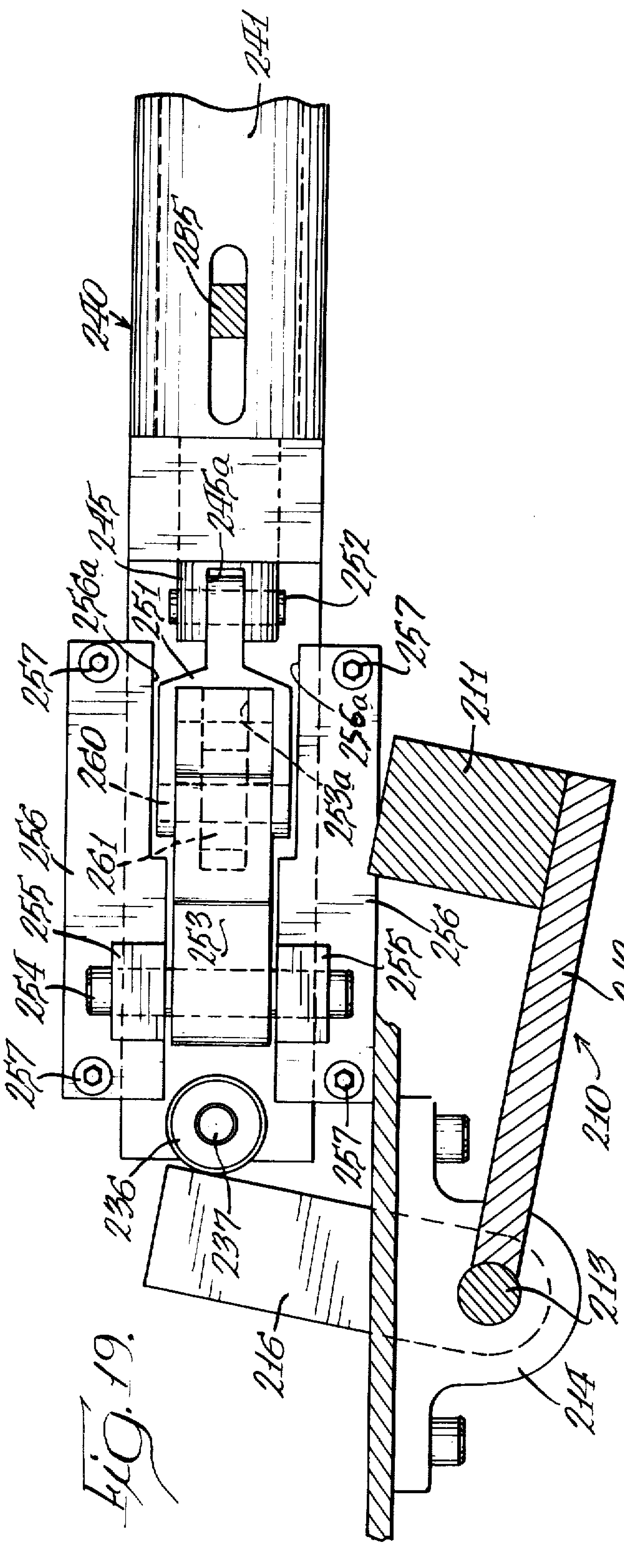

Fig. 19.

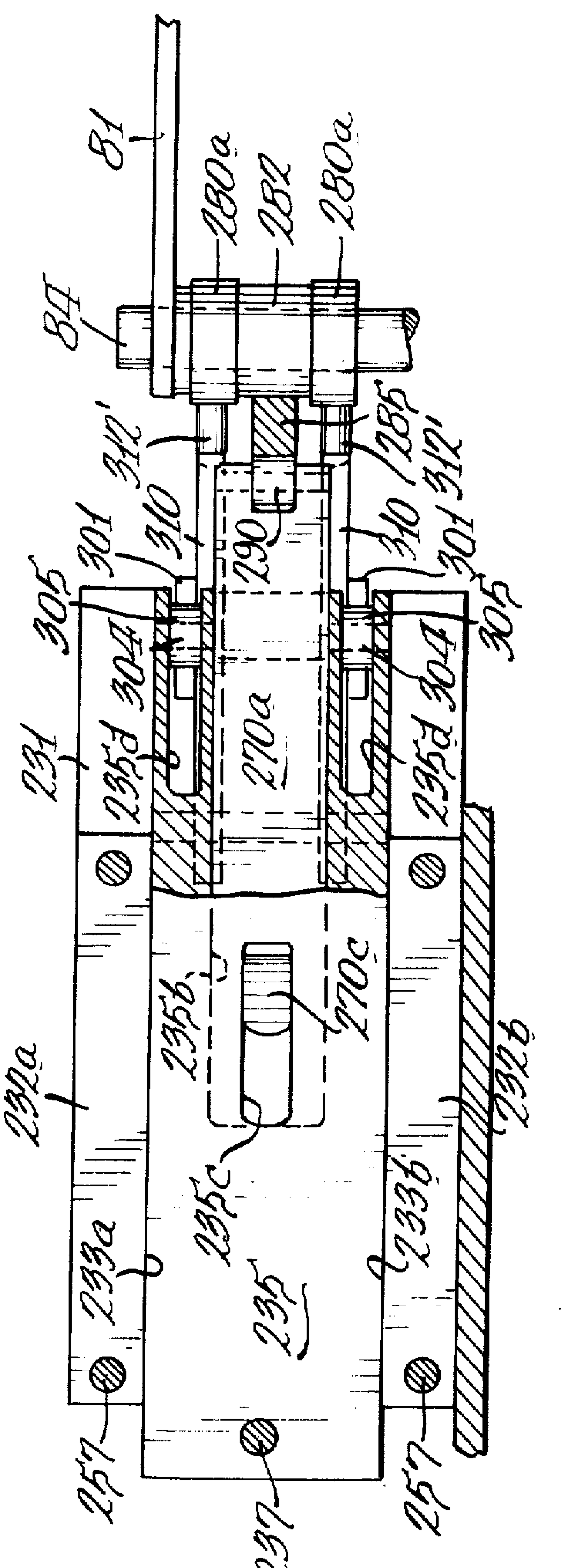

Fig. 20.

STRAP DISPENSING METHOD AND APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to a new and improved strap dispenser, particularly a dispenser in which strap is supplied in coils of substantial weight, wherein the weight of the coil is used to initiate and terminate dispensing with minimal shock loads to the dispenser and without strap overrun.

It has been found that the mass and inertia of strap coils, particularly when they are fresh and have relatively great weight, produce a large shock load on the strap feeding mechanism of the strapping machine when dispensing is terminated. This is due to the stopping mechanisms of the prior art, which must absorb the large rotational energy of the rotating coil to terminate its rotation.

Another problem associated with prior art strap dispensers is that rotational inertia will cause the strap from these coils to overrun when the feed to the strapping machine has been terminated, unless the rotation is very quickly terminated. This overrunning can leave a substantial length of strap lying loose between the coil and the feed mechanism of the strapping machine, which can cause tangling and which increases the opportunity for snagging of the strap when feed is again commenced.

Various apparatus has been suggested in the past for dispensing strap in an effort to meet the above mentioned problems, and representative prior art patents are discussed herebelow. For various reasons these apparatus are not particularly suitable for large mass coils.

Forbes U.S. Pat. No. 1,144,831, discloses a tubular feeding slide to prevent the coil from opening during dispensing, but does not disclose any means for solving the overrunning and stopping problems. In Porter U.S. Pat. No. 2,155,771, circumferential ring springs are disclosed to provide a continuous braking action to prevent overrunning of the strap. However, such continuous braking inhibits the dispensing of strap and produces excessive wear on the brake elements. These disadvantages were recognized in Green U.S. Pat. No. 2,506,554, which discloses a rim riding rotating feeder brake which reduced, if not substantially eliminated, braking during the dispensing operation. However, the Green brake has little applicability to large mass coil dispensers which generate high rotational energy. Coils were eventually power fed as in Leslie U.S. Pat. No. 2,779,410, in which the strapping was drawn from the center of the coil, and back pressure on the feed was used to prevent overrunning.

SUMMARY OF THE INVENTION

The improved strapping dispenser comprising the present invention has been designed for use primarily in connection with the dispensing of continuous steel strapping at a station where it is caused to encircle an object to produce a loop, which is then tensioned about the object by a power operated strapping machine preparatory to adjoining the strap ends and severing the trailing end of the strap to free the strapped object from the strapping machine.

The strapping dispenser is of the reel type, which is to say that the coil of strap which is wound in involute fashion is mounted upon a rotatable hub which, itself, is axle mounted. The hub and coil, in effect, constitute a rotatable spool from which the strapping material is pulled in tangential fashion, as required, thus causing spool rotation during actual strap feeding operations.

The present invention utilizes the mass of the coil (up to 1,000 lbs. and even larger) to initiate rotation; as the coil is allowed to fall, by changing the potential energy of the coil into rotational energy. Strap dispensing is terminated as a result of the coil mass, by locking the coil from rotation and converting its rotational energy into a vertical force thereby lifting the coil and dissipating its energy. In this manner, overrunning of strap is eliminated and shock loads to the dispenser are minimal.

The axle on which the hub of the coil of strap is mounted includes separate inner and outer coaxial axles, each axle being located relative to and supported from a frame by support arms, which have one end fixedly connected at right angles to their respective axles. The other ends of the support arms are movably supported in horizontal guide tracks of the frame, and horizontal movement of these ends of the arms results in raising and lowering the spool. The axles are constrained to move in a vertical guide channel of the frame to assure that the spool moves in the vertical direction as the frame mounted ends of the support arms move in the horizontal direction.

A one-way clutch mechanism is connected between the hub and the outer axle to assist in retaining the spool in the rest position, and to initiate rotation of the spool when demand for strap occurs. A key mechanism is provided for selectively connecting the inner axle to the hub to terminate spool rotation causing the rotational energy of the spool to lift itself. The key mechanism also assists in retaining the spool in the rest position. A dancer arm assembly is provided to sense strap tension, and a coupling mechanism is actuated by the dancer arm assembly to engage and disengage the key mechanism.

Prior to commencement of dispensing, the spool is positioned at an elevated position relative to the frame and supported by the arms, which are approximately horizontal in this position, through the key mechanism, and the one-way clutch. As strap is required, the coupling mechanism is actuated to disengage the key mechanism, and the spool falls vertically, while the support arms pivot downwardly and the frame mounted ends of the support arms move toward one another in the horizontal guide track. As the spool falls, the one-way clutch remains engaged and rotation of the spool is initiated as the support arms pivot. After the support arms have moved together and the spool has reached the strap feeding position, the spool over-runs the clutch and dispensing of strap commences.

Intermediate braking is provided by a brake actuated by the dancer arm as demand for strap fluctuates. When demand ceases, the keys are actuated, locking the spool to the inner axle and the arms connected thereto. The rotational energy of the spool causes the spool supporting arms to pivot about the point of contact with the horizontal guide tracks thus causing the spool to rise vertically, dissipating its energy in the form of work. As the spool rises, the support arms are pivoted upwardly. After the spool has reached equilibrium, it is again supported in the upper vertical position on the arms through the key mechanism and clutch. Thus, through the use of the stored potential energy and rotational energy in operating the dispenser, the dispensing mechanism of this invention substantially

eliminates shock loading and strap overrun while providing quick response to strap demand.

Strap coils are machine wound and consequently are of varying inner and outer diameters and width. In order to compensate for various size inner diameters and to facilitate mounting of the coil of strap, a novel mounting mechanism is also disclosed. This mechanism provides for the acceptance of coils of a variety of inner diameters and widths, yet is adapted to securely mount the coil to the hub to assure conjoint rotation therewith. The coil mounting mechanism includes a plurality of radially movable members, which are attached to the hub by two bar linkages, one link attached to the radial member, the other to the hub. The links are pivotally connected at corresponding ends and are operated by transversely movable spools which move the members radially. The spools for each radial member are operatively connected, so that the radial members may be moved inwardly and outwardly conjointly for mounting the coil of strap. The mounting means includes a movable side plate which, when a coil is mounted, applies a side force to the coil to prevent axial movement thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side elevation view of a strapping dispenser embodying the principles of the present invention and showing the same in its position of rest;

FIG. **2** is a top plan view of the strapping dispenser of FIG. **1**, with certain portions broken away for clarity of illustration;

FIG. **3** is a front elevation view, partially in cross section of the dispenser of FIGS. **1** and **2**;

FIG. **4** is a fragmentary plan view of an overcenter mechanism that is used to control rotation of the dispenser spool;

FIG. **5** is a schematic view of the dispenser in its rest position;

FIG. **6** is a schematic view of the dispenser in its strap dispensing position;

FIG. **7** is a schematic view of the dispenser in an intermediate position during movement from the strap dispensing position to the rest position;

FIG. **8** is an enlarged fragmentary sectional view taken generally centrally of the dispenser, and illustrating the various mechanisms in the run position;

FIG. **9** is a fragmentary sectional view in the rest position with the coil mounting mechanism removed for clarity of illustration.

FIG. **10** is a sectional view of the one-way overrunning device, taken along plane **10—10** of FIG. **9**;

FIG. **11** is a sectional view of the radial keying system, taken along plane **11—11** of FIG. **9**;

FIG. **12** is an elevation view of the key actuating cam and rollers;

FIG. **13** is an elevation view, partially in cross section of the coil mounting mechanism;

FIG. **14** is a sectional view of the coil mounting mechanism, with the axle mechanism removed for clarity of illustration, taken along plane **14—14** of FIG. **13**;

FIG. **15** is a sectional view of the coil mounting mechanism taken along plane **15—15** of FIG. **14**;

FIG. **16** is a fragmentary sectional view taken generally centrally of an alternate embodiment of the dispenser, and illustrating the various mechanisms in the run position;

FIG. **17** is an enlarged fragmentary side elevation view with certain portions broken away for clarity of illustration, illustrating the over-center mechanism used to operate the mechanism in FIG. **16** in the rest position;

FIG. **18** is a side elevation view similar to FIG. **17** illustrating the over-center mechanism in an intermediate start position;

FIG. **19** is a sectional view taken along line **19—19** on FIG. **17**; and

FIG. **20** is a sectional view taken along line **20—20** on FIG. **17.**

DESCRIPTION OF THE PREFERRED EMBODIMENT

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail a preferred embodiment of the invention, with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated. The scope of the invention will be pointed out in the appended claims.

Referring now to the drawings, the strap dispensing device is designated in its entirety by reference numeral **10** and is comprised of three principle assemblies; namely, a frame **11**, a dancer arm assembly **80**, and an axle assembly **31** including a hub **32** carrying a coil of strap C.

Referring to FIGS. **1**, **2** and **3**, the frame **11** includes a rectangular base section **12** formed from box members **13** and **14** adapted to support the dispenser on the floor or other suitable base; and upwardly converging inclined members **15** and **16** and cross member **17** at each side of the frame which define essentially A-shaped supports. Horizontal guide channels **18** are provided on each side of the frame, and are secured to the upper ends of members **15** and **16** and to the upper end of vertical supports **19** at the front portion of the dispenser. A lateral frame member **21** braces the rear ends of the guide channels **18.** Finally, frame **11** includes vertical guide rails **20** which extend upwardly from the central portion of each cross member **17** to one of the guide channels **18.**

The horizontal guide channels **18** (FIGS. **8** and **9**) are formed by horizontal support members **22** and inverted L-shaped weldments **23** to provide a three side inwardly opening channel. Members **22** are attached from beneath at the central portion to the converging members **15** and **16** and at the forward ends to vertical supports **19.** The upper surfaces **22***a* of the members **22** are coplanar and horizontally disposed to provide a smooth rolling surface for rollers **37** and **40,** hereinafter described. The horizontal portions **23***a* of weldments **23** function to contain the rollers **37** and **40** within the guide channels as the coil rises vertically during the stopping cycle, as discussed below. The forward ends of the guide channels **18** above supports **19** are open to allow the coil C, hub **32** and axle assembly **31** to be removed from the frame, while the rearward ends of channels **18** are closed by cross member **21** which extends therebetween. The vertical guide rails **20** (FIGS. **8** and **9**) provide a smooth vertical bearing surface upon which axle bearings **50** bear while the coil is moving vertically, as is also discussed below.

The coil C of strap is mounted to the hub **32** by a mechanism **130** (FIG. **8**) discussed in detail below, that assures the conjoint rotation of the coil with the hub without relative motion therebetween and permits the

hub to accept coils of varying inner diameter. The hub **32** is formed of three coaxial pieces **32***a*, **32***b* and **32***c*, which may be welded or joined by other suitable means, such as by the bolts **180** shown in FIG. **13**, and hub is provided with rims **132** and **132***a* which support the sides of the strap coil which is mounted therebetween. The axial portions of the hub **32** are mounted on an outer axle **33** by axially spaced pairs of bearings **34** and **35** and one-way clutches **52**, between bearings **34** and **35**. Clutches **52** are free to rotate in the direction of strap dispensing, as will hereinafter appear.

Axle **33** is formed of two coaxial segments **33***a* and **33***b*, and the outer end of each segment is connected to an arm **36**, as by a key **43**. Arms **36** are positioned at right angles with respect to axle **33** and are supported on the surface **22***a* of guide channel **18** by rollers **37**. Rollers **37** are attached to arms **36** by lateral tube weldments **44** which contain coaxial mounting studs **45** upon which rollers **37** are attached by nuts **46** and washers **47**.

Axle **33** is rotatably mounted on a hollow inner axle **38** by axially spaced bearings **48**, and each end of axle **38** is connected to arms **39**, as by keys **49**. Arms **39** support axle **38** from the horizontal surface of the guide channels **18** through roller bearings **40** which are connected to the arms **39** in the same manner as rollers **37** are mounted to arms **36**. Each end of axle **38** is provided with a bearing **50** which is retained thereon by a spacer and clip ring **51**, and bearings **50** ride against vertical guide rail **20** during the vertical travel of the axle assembly **31**.

The one-way clutches **52** are shown in detail in FIGS. **8**, **9** and **10**, but it will be appreciated that this type of device may be replaced by a variety of other mechanisms including a ratchet drive, fiber clutch or any suitable one-way overruning device without departing from the scope of the invention. Each clutch **52** includes a smooth outer race surface **52***a* formed interiorly of hub members **32***a* and **32***c* and upon which spindle bearings **53** may freely roll. Clutches **52** further include an inner surface **52***b* formed on the outer surface of axle portions **33***a* and **33***b*, with surface **52***b* being provided with a plurality of equally circumferentially spaced tangential steps.

As hub **32** rotates in a clockwise direction relative axle **33**, as indicated by the directional arrow in FIG. **10**, the spindle bearings **53** are free to rotate in the heel portion of the steps of surface **52***b* and the clutch overruns. However, when axle **33** rotates in a clockwise direction relative to hub **32**, the spindle bearings **53** move tangentially on surface **52***b* and prevent further rotation in this direction since the clearance between surfaces **52***b* and **52***a* is reduced at the toe or end portion of the tangential surface. As will be described in more detail below, when the coil **C** is permitted to fall vertically in order to initiate the dispensing of strap, both the hub **32** and axle **33** rotate together so that there is no relative movement therebetween. The rotation of both elements during the falling phase of the coil accelerates the coil from the rest position to initiate rotation thereof, although during the falling phase there is no relative rotation between hub **32** and axle **33**. When the axle means **31** is in the rest position (FIG. **5**), the coil is supported and prevented from rotating by the combined actions of one-way clutches **52** and a keying system which releasably couples hub **32** and inner axle **38**.

The keying system can be best understood by considering FIGS. **8**, **9**, **11** and **12**, and with specific reference to FIG. **11**, the system includes a plurality of spaced abutments in the form of inserts **54** arranged radially in hub members **32***b* and cooperating with diametrically opposed keys **55** extending outwardly of axle **38**. The outwardly facing engagement surfaces **54***a* and **55***a* of inserts **54** and keys **55**, respectively, are set at complementary angles to each other thereby directing a component of the coil's weight towards the center of the axle assembly when the keys and inserts are engaged. This directed component of weight assures that the keys and inserts will remain engaged while the axle assembly is in the rest position of FIG. **5** and also dissipates a portion of the rotational energy as the keys engage the inserts to stop the hub **32** from rotating. Additionally, this force component is utilized to force the keys radially inwardly to initiate rotation, as discussed below. It will be appreciated that hub member **32***b* and the inserts **54** are free relative to the outer axle **33** so that rotation of the hub about the outer axle is controlled through the one-way clutches **52** only.

The movement of keys **55** is controlled by a slidable assembly contained in the center of the inner axle **38**, and which is actuated through the action of the strap on a dancer arm assembly to be hereafter described. The inner axle **38** is in the form of a hollow shaft to provide for reception of the actuating mechanism, and shaft **38** is provided with diametrically opposed radial passages **38***a* in which the keys are slidably located. The key actuating mechanism includes bearings **60** which are each mounted in a slidable housing **61** at each end of the shaft **38**, axially movable spools **62** slidably positioned within shaft **38** inwardly of housings **61**, and cam member **63** which is positioned between the inner hub **62***a* of each spool. These slidable members are retained within the interior of shaft **38** by inwardly facing clip rings **64** at each end of shaft **38** and which act against a shoulder on housing **61**. As can be best seen in FIG. **12**, cam **63** includes a pair of longitudinally spaced recesses or pockets **65** in opposite faces thereof, with cam **63** further including flat parallel surfaces between and on opposite sides of recesses **65**. Reacting members in the form of rollers **66** are interposed between cam **63** and keys **55**, and the rollers **66** are mounted on transversed spindles **68** that are each slidably mounted in an outwardly facing slot **69** in a guide member **66** which supports cam **63** through mounting blocks **67** at either end thereof. It will be understood that slots **69** permit rollers **66** to move inwardly and outwardly relative to the pockets **65** as cam **63** is moved relative to guide member **66'**. For example, as the cam **63** is moved to the left from the position of FIG. **9** to the position of FIG. **8**, as occurs upon demand for strap, the component of the weight of the coil which is directed toward the center of the axle assembly (because of the angle of contact between keys **55** and inserts **54**) forces rollers **66** downwardly into pockets **65** to disengage the keys. The right-hand spool **62** then contacts the right-hand blocks **67**, thus permitting the rollers **66** to be moved to the left-hand position relative to surfaces **55***b*, as illustrated in FIG. **8**. This movement of the rollers **66** to the left-hand portion of the keys **55** positions the rollers for moving the keys outwardly when the spools are moved to the right, as occurs when demand for strap ceases. When the spools **62** are moved to the right from the position of FIG. **8** to the position of FIG. **9**, the rollers **66** are forced to ride up

the ramp portion of the pockets **65** forcing the keys **55** outwardly into engagement with the inserts **54** to positively couple the hub **32** to shaft **38** to return the dispenser to the rest position, as will be explained hereafter. As the spools **62** continue to move to the right, the inner left-hand spool **62***a* contacts the left-hand guide block **67** thus causing the rollers to move to the right-hand portion of surface **54***b*.

In the preferred embodiment, the movement of the spools **62** is achieved through an over-center spring loaded mechanism **86** which is activated by the dancer arm assembly **80,** as can be best seen in FIGS. **1–4.** While the over-center mechanism is hereafter described in detail, it will be appreciated that other linkages, or switches or valves with a suitable connection to a power device, may be provided to move the spools. The dancer arm assembly **80** is comprised of two arms **81** adjacently disposed to either side of the hub rim and pivotally mounted to the frame cross member **17** by pins **84** to provide a fulcrum. The dancer arms **81** converge at their free ends to journal mount a roller **82,** as by shaft **83.** The dispenser is activated and deactivated by strap demand which is communicated to the dispenser through the dancer arms **81** and roller **82.** To this end, the strap is fed from the coil downwardly under roller **82** and then upwardly over guide roller **83'** (FIGS. **5–7**) and to a strapping machine. In this manner, demand for the strap causes the dancer arm to pivot upwardly about the fulcrum point as demand for strap increases and downwardly as strap demand decreases.

The rear portion of one of the dancer arms **81** includes a generally perpendicularly extending actuating portion **85** which is apertured to rotatably receive a shaft **87** which includes hemispherical end portion **88** which bears against dancer arm portions **85. Shaft 87** is connected to the horizontal portion of an upwardly extending spool moving member **90** by a vertical pivot pin **89** which is seated within a slot **90***a* in member **90.** As can be seen in FIG. **2,** spool operating members **90** are provided at opposite sides of the dispenser frame, and each member **90** is pivotally attached to a frame cross member **17** by a vertical pin **91. Each member 90** is provided with an inwardly facing actuator portion **92** which bears against one of bearings **60** to operate the spools **62** axially within shaft **38** as the members **90** are pivoted. To provide the energy for operating the members **90** and spools **62,** shaft **87** is provided with a sleeve **94** which bears against pin **89** and which is loaded by a spring **93.** The spring load on pin **89** is adjustable by means of nut **95** which may be moved on a threaded portion **87***a* of shaft **87** to appropriately control the force generated against bearings **60.**

Assuming that the dispenser is in the rest position as shown in FIGS. **1** and **5,** when demand for strap occurs, dancer arms **81** are pivoted upwardly to move the actuating portion **85** along a counterclockwise arcuate path, as viewed in FIG. **1.** This movement causes the shaft **87** to pivot in a counterclockwise direction about pin **89** against the bias of spring **93,** and as the shaft **87** passes over an imaginary line extending between pins **89** and **91,** the over-center assembly **86** snaps into the position shown in FIG. **4** and axially shifts the spool assembly from the position of FIG. **9** to the position of FIG. **8.** In a similar manner, when demand for strap ceases, dancer arms **81** pivot downwardly in a clockwise direction, as viewed in FIG. **1,** to move the actuating portion **85** in an arcuate clockwise path. This movement causes shaft **87** to pivot in a clockwise direction about pin **89** until the shaft **87** passes over an imaginary line between pins **89** and **91,** at which time the over-center mechanism snaps to the position shown in FIG. **2** to move the spool assembly from the position of FIG. **8** to the position of FIG. **9.**

Since the spool operating members **90** are spring loaded on only one side in the illustrated embodiment, as shown in FIG. **2,** the spool operating members are interconnected through a linkage system extending around the rear portion of the frame. To this end, the directly loaded member **90** is connected to a rearwardly extending link **100** by pin **89,** while the dependent member **90** is connected to a rearwardly extending link **101** by a pin **89'**. Links **100** and **101** are pivotally attached to a cross link **103** at their end portions by pins **104,** with link **103** being pivotally attached at its center portion to frame cross member **21** by pin **105** and bushing **106** to provide a fulcrum for transferring the motion from the directly loaded member **90** to the dependent member **90.**

To provide for intermediate braking action of the coil during the dispensing cycle, the dancer arms **81** are attached to a rim braking system. The braking system is comprised of a brake lever **110** which is pivotally attached to frame base member **13** by pin **111,** and which is provided with a brake shoe **112** which bears against the coil rim. It should be understood that a separate brake member may be provided for each rim, or that a single brake member may be provided which engages both rims. Lever **110** is actuated by the rotation of the dancer arms **81** about their fulcrum point by a spring **113** that is attached to the middle portion of lever **110** and the cable **114** is attached to the rear portion of one of dancer arms **81.** Thus, as the dancer arms rotate clockwise due to a decrease in strap demand, the brake lever **110** and shoe **112** are raised upwardly against the rim to provide intermediate braking. However, if strap demand has ceased, the dancer arms **81** will continue to rotate clockwise and actuate the over-center mechanism **86** to cause the keys to engage the inserts and stop coil rotation completely.

In the operation of the dispensing unit, starting from the stopped position (FIG. **5**), the hub **32** on which the coil is mounted and axles **33** and **38** are supported in the rest position at an elevated position relative to the vertical guide rail **20** by axle arms **36** and **39** acting upon surface **22***a* of guide channels **18.** In this position the arms **36** and **39** are in an approximately horizontal position, and the hub **32** is constrained from rotation about axle arms **39** by the engagement of the keys **55** against the inserts **54** and constrained from rotation about axle arms **36** through the one-way clutches **52.** In the rest or stopped position, the guide rollers **50** are positioned adjacent the upper portion of the vertical guide rails **20** (FIG. **9**), and the spool operating members **90** are positioned so that the inserts **54** and keys **55** are engaged. Since the coil is in this upper position, the rims of the hub are out of contact with the brake shoe **112.**

Upon demand for strap, initiated by a strapping machine, the dancer arms **81** are forced to pivot upwardly activating the over-center mechanism **86.** As the dancer arms **81** reach the designated start position, the over-center mechanism causes the spool **62** to move to the left, i.e., from the position of FIG. **9** to the position of FIG. **8.** The movement of spools **62** causes the cam **63** to move to the left also, thereby disengaging the

inserts **54** and the keys **55** as the rollers **66** enter the pockets **65** in cam **63.** As is described above, the keys **55** due to their angle of contact with the inserts **54** direct a component of the coil's weight towards the center of the axles **33** and **38.** This force keeps the keys **55,** rollers **66** and cam **63** in constant contact with each other and working as a unit. As the cam **63** moves under the action of the over-center mechanism, the rollers **66** and guide member **66'** roll on the cam and the keys. As the rollers **66** approach the pockets **65** in cam **63,** the force component forces the keys **55** and rollers **66** inwardly, disengaging the keys from the inserts **54** and the hub assembly **32.** Due to this disengagement, the hub **32** is free to fall vertically and is guided by rollers **50** acting against the vertical guide rail **20.**

As the hub **32** falls, the one-way clutches **52** holding the coil and hub to arm **36** remain engaged since there is no relative movement between the hub **32** and axle **33.** The hub **32** is forced to rotate about the point of contact between rollers **37** on arm **36** and upper surfaces **22***a*. The coil C continues to fall until arms **39** have moved into a vertical alignment with axles **33** and **38,** at which time the hub **32** begins to overrun the arms through the one-way clutches **52** (FIG. **6**).

The hub is then continually accelerated by the dancer arms **81** as they maintain constant tension in the strap between the demand source and the coil. If during the feed cycle, the hub speed exceeds the demand speed, the dancer arms **81** will pivot down and move the brake shoe **112** into contact with the hub rim to provide intermediate braking. The brake shoe **112** will slow the hub down until the speed of the hub is the same or slower than the demand speed. As demand source speed increases, the dancer arms **81** will pivot upwardly and disengage the brake shoe **112** from the coil rim (FIG. **6**).

When the demand for strap is terminated, the hub **32** will tend to continue to rotate and feed off strap due to its rotational inertia. The dancer arms **81** will then pivot downwardly (FIG. 7), moving the brake shoe **112** into contact with the hub rim and, because of the spring connection in the brake mechanism, the dancer arms will continue downwardly to the stopped position. At the stop position, the over-center mechanism **86** is again actuated to force the spools **62,** cam **63** and guide member **66'** to move the rollers **66** out of the pockets **65** and into the engaged position, thus forcing the keys **55** radially outward to engage the inserts **54** (FIG. **9**). As the keys **55** engage the inserts **54,** rigid contact is again initiated between axle **38** and hub **32.** Support arms **39** now act as pivot arms between the hub **32** and the upper surfaces **22***a* and the hub **32,** in attempting to rotate the axle **38,** creates a moment about the point of contact between rollers **40** on arms **39** and the upper surfaces **22***a*, thus causing the hub to pivot upwardly about these arms. As the hub moves upwardly, the support arms **36** and **39** move away from each other in proportion to the rotational energy of the coil as shown in FIG. **5.** The coil C continues to rise until all the rotational energy is dissipated in the form of work generated in lifting itself relative to the frame. At this point, the coil has reached equilibrium and is locked in the up position (FIG. **5**). The weight of the coil C is supported by arms **36** through the one-way clutches and by arms **39** through the engaged keys **55** and inserts **54.** The coil will remain in the locked up rest position until demand from the strapping machine again causes the dancer arms to pivot upwardly into the start position.

The dispenser of the present invention also includes a novel mechanism **130** for clamping the inner diameter of a coil of strap, with the clamping means being adjustable to accept coils having different inner diameters and for accepting coils of different widths. The coil clamping means is illustrated in the clamped position in FIGS. **8** and **13–15** and includes a plurality of circumferentially spaced clamping shoes **131** (four such shoes being utilized in the illustrated embodiment), with the shoes **131** each being movable between a pair of parallel coil retaining rims or flanges **132** and **132***a*. Rim **132** is removable for loading of new strapping coils. Each shoe **131** has an arcuate outer surface **131***a* (FIG. **13**) to complement the interior surface of the strapping coil. Follower tabs **155** may be provided at opposite ends of shoes **131** to bear against guides **154** during movement of the shoes.

The clamping shoes **131** are movable inwardly and outwardly simultaneously to decrease and increase the effective diameter of the hub, and identical linkages **134** are provided for moving each clamping shoe **131.** Linkages **134** each include a pair of parallel first links **135** that are connected at one end by pin **136** to a clamping shoe **131,** with the opposite end of links **135** being pivotally connected by pin **138** to a pair of parallel second links **137,** which are pivotally connected at their opposite end by pin **160** to hub portion **32***b*.

An identical linkage operating mechanism is provided for each linkage means **134,** and each mechanism includes an adjusting shaft **150** which is rotatably supported at its opposite ends by bushings **151** and **152.** Each shaft **150** extends through its respective bushing **151** to mount a disc stop **153** at the end thereof. Each end stop **153** is axially movable with the end of its shaft **150** in a counterbore **153***a* defined in bushing **151** and fixed hub plate **161.** A cradle **140** is mounted for axial movement along each adjusting shaft **150.** The cradle includes an annular plate **141** which has internally threaded portions that receive the externally threaded portion of shafts **150** so that the cradle is axially movable relative to shafts **150** when shafts **150** are rotated. A pair of spaced rollers **139** are mounted upon pin **138** and are held against plate **141** by a U-shaped cover plate **143** that is secured in spaced parallel relationship to plate **141** by screws **144** and spacers **142.** From the foregoing, it will be appreciated when shafts **150** are rotated, the cradle assembly **140,** including portions **141–143,** will move axially relative to the shafts and pivot the linkage means **134** about pin **160** to move the clamping shoe inwardly or outwardly, depending upon the direction of rotation of shafts **150.**

To provide for conjoint movement of shoes **131,** each shaft **150** is provided with a sprocket **156** which is keyed thereto. The sprockets **156** are interconnected by two endless chains **157** which are operated by rotating one of the shafts **150** as by a key in socket **158** formed in the end of one of the shafts (FIG. **13**).

In order to mount a new coil of strap, the empty hub **32** is removed from the frame **11** by lifting the axle assembly **31** upwardly so that rollers **50** are clear of rails **20.** The entire assembly may then be rolled to the forward end of channels **18** and removed. The means for accepting a new coil (which may be of a different width) is provided by hub side plate **162** which is axially movable relative to hub **32.** By rotating shafts **150,** plate **141** is moved into abutting relationship with the

inner end 151*a* of each bushing **151.** At this point, shoes **131** are fully retracted. Continued rotation of shafts **150** causes the shafts to "unscrew" themselves from plate **141** thus causing plate **162** to be moved outwardly until stops **153** seat in counterbores **153***a*. A clearance is produced between rim **132** and plate **162** to allow the rim to be removed and a new coil placed in position. To this end rim **132** is provided with four, spaced apart inwardly directed radially projections **132***a*, and plate **162** is provided with complementary cut outs **162***a*. To remove rim **132,** it is rotated to place each projection in register with a cut out and the rim is lifted clear of the plate **162.** After a new coil is positioned on the hub, the rim projections are inserted through the cut outs and rotated to place the leading end of each projection in abutment with a stop stud **162***b*, FIG. **13.** Thus rim **132,** which is reinforced by radial struts **133,** is secured against axial movement outwardly by plate **162.**

After a new coil has been positioned and rim **132** is replaced, shafts **150** are rotated in the opposite direction to cause them to "screw" into plate **141.** This rotation causes plate **162** to be moved inwardly and draws rim **132** into engagement with the side of the new coil. Continued rotation of shafts **150** draws plate **141** away from bushing **151** to cause shoes **131** to clamp against the inner diameter of the coil, as described above. After the shoes **131** clamp the inner diameter of the coil, continued rotation of the shafts **150** produces a squeezing action between plates **141** and **162** which results in a side force through rim **132** to maintain the rim against the side of the new coil.

Referring now to FIGS. **16** through **20,** there is illustrated an alternate embodiment for actuating the hub assembly. The alternate mechanisms are conveniently used with the dispensing device previously described with only minor substitutions and deletions of mechanisms previously described. With particular reference to FIG. **16,** elements corresponding to those elements previously described are designated by the same numerical designation. In this embodiment, the keys **55** are actuated by a single over-center mechanism, described in detail below, which forces the spool **62** to the left, FIG. **16,** to initiate strap dispensing. The dispensing operation is terminated and the hub raised to an elevated position, as described above, by spring mechanisms within the inner axle **38,** rather than by an over-center mechanism on the opposite side of the axle.

Referring to FIG. **16,** it will be observed that the right-hand mechanism within inner axle **38** is identical to that previously described. To initiate hub rotation cam **63** and the left-hand guide block **67** are moved to the left, and compress a spring-loaded return system **200,** which is contained within the left-hand portion of the inner axle **38.** The spring return mechanism **200** includes a circular mounting block **201** positioned at the left-hand end, FIG. **16,** of the inner axle **38** and is secured thereto by means of spring clip **64.** Block **201** locates an elongated tube **202** which extends therefrom to a location spaced from the center of the dispensing hub. Tube **202** is positioned axially within the inner axle **38** and has interior dimensions corresponding to the outer dimensions of cam **63** so that the left-hand portion of cam **63** is slidably received within the tube. A piston **203** is slidably mounted within tube **202** and biased outwardly against the left-hand end of cam **63** by means of a compression spring **204** disposed between piston **203** and block **201.** In this manner, as cam **63** moves to the left, it forces piston **203** to the left and compresses spring **204** to provide a returning force for the cam when dispensing is to be terminated.

A second compression spring **206** is mounted concentrically about tube **202** and is disposed between block **201** and the left-hand guide block **67** so that as this guide block is moved to the left, spring **206** is compressed to provide a returning force on the left-hand guide block **67** to move the guide member **66'** when dispensing is to be terminated. The compressive force generated in springs **204** and **206** is sufficient to operate the keys and the over-center mechanism. In this manner springs **204** and **206** will cause spool **62** to move to the right if the over-center mechanism does not overcome the compressive forces of the springs.

FIGS. **17** and **19** illustrate the over-center mechanism for operating the right-hand spool **62.** Mechanism **210** is freely rotatable and includes an inwardly facing actuator portion **211,** similar to actuator portion **92,** FIG. **4,** which is mounted at the end of a pivot plate **212.** Plate **212** is attached at the opposite end to a vertical shaft **213** which is rotatably mounted to the machine frame at spaced vertical locations by means of bearings **214.** Shaft **213** extends below the elevation of the lower bearing **214** and is provided with an actuator arm **216.** Actuator arm **216** is pivoted counterclockwise, as viewed in FIG. **19,** to cause actuator portion **211** to bear against bearing **60,** FIG. **16,** and thus cause the keys **55** to disengage inserts **54** and allow the hub to fall vertically and initiate strap dispensing. Conversely, if the force of springs **204** and **206** is greater than the force on arm **216,** the over-center mechanism will pivot clockwise and dispensing will be terminated.

Actuator arm **216** is forced to rotate counterclockwise by means of a spring-loaded mechanism **230** which is controlled by the right dancer arm **81** and primed by the axle assembly as it falls from its elevated position to the dispensing position. The spring loaded mechanism **230** includes in essence three sub-assemblies (1) a trigger assembly for operating a spring-loaded cylinder **240** to cause actuator arm **216** to be rotated counterclockwise and thus operate the over-center mechanism **210,** (2) a latching mechanism for holding and releasing actuator portion **211** from a biased position against roller **60** and (3) a resetting mechanism for priming the cylinder **240.** Nonetheless, the mechanisms for performing these functions operate cooperatively and interdependently to form a true combination.

The spring-loaded mechanism **230** is mounted on the frame below the elevation of the actuator member **211** on a horizontal plate **231** extending inwardly from cross member **17.** Plate **231** is provided with two elongated spacers, **232***a* and **232***b*, FIG. **20,** which extend longitudinally along each side of the plate and define two inwardly facing guide surfaces **233***a* and **233***b*. A generally rectangularly shaped slide **235** is slidably positioned between surfaces **233***a* and **233***b*. Slide **235** mounts a horizontally disposed roller **236** on its upper surface at the left-hand end, FIG. **19,** by means of stud **237.** Roller **236** is utilized to engage and rotate actuator arm **216** counterclockwise to initiate strap dispensing.

Slide **235** is operated by means of spring-loaded cylinder **240** mounted at the right hand end of plate **231.** Cylinder **240,** FIG. **17,** includes an outer sleeve **241,** a compression spring **242** mounted concentrically within sleeve **241,** and disposed between one end of the sleeve

(not shown) and a piston **243** at the other end. Spring **242** is designed to generate a force sufficient to overcome the force of springs **204** and **206** and operate the over-center mechanism. Piston **243** is provided with an annular shoulder portion **244** at its exposed surface and a reduced diameter portion **245** which extends outwardly therefrom. Slide **235** is provided with a collar portion **235***a* at its right end which is slidably mounted on the reduced diameter portion **245** of the piston **243** and engagable with shoulder portion **244.** As compression spring **242** expands, slide **235** is forced to the left as viewed in FIG. **17** to cause roller **236** to rotate actuator arm **216** and thus operate the over-center mechanism **210.** Slide **235** is constrained to slide between surfaces **233***a* and **233***b* by two elongated guides **256** which overlie the edges of the slide and top surfaces of spacers **232***a* and **232***b*. Guides **256** are secured to plate **231** by bolts **257** which extend through spacers **232***a* and **232***b*.

Cylinder **240,** shown in its primed state in FIG. **17,** is maintained in this position by means of a toggle linkage **250.** Linkage **250** includes a Y-shaped link **251,** FIG. **19,** pivotally mounted at its leg in a vertical U-shaped cut-out **245***a* within the reduced diameter portion **245** of the piston by means of pin **252,** and second link **253** which is pivotally mounted at one end by means of pin **254** to mounting blocks **255,** which extend upwardly from guide members **256.** Link **253** is contoured at its upper surface, to be described in greater detail below, and is provided with a vertical cut-out **253***a* at the end opposite pin **254.** The yoke portion of link **251** encompasses the abutting end of link **253** and is pivotally attached thereto by means of a pin **260. Pin 260** also mounts a roller **261** within cut-out **253***a* of link **253.** The guides **256** are provided with inwardly facing clearance cut-out **256***a* which permit the toggle linkage to be flexed downwardly and when the toggle linkage is flexed downwardly roller **261** bears against the inclined surface **270***c* of a second slide (described in detail below) which acts as a support for the linkage in the primed position. Thus it will be appreciated that when the toggle linkage **250** is in the position shown in FIG. **17,** i.e. with the center of pin **260** below the center line between pins **252** and **254,** the piston **243** is maintained in its retracted or compressed condition preparatory for operation.

To initiate strap dispensing, the toggle linkage is operated by means of a second slide **270** FIGS. **17** and **20** which includes an elongated section **270***a* which is slidably positioned in a generally rectangular cut-out **235***b* in the bottom surface of slide **235** and an upwardly extending actuator portion **270***b* which protrudes through a cut-out **235***c* in slide **235.** Actuator portion **270***b* is provided with an angled bearing surface **270***c* for supporting roller **261** when piston **240** is in the primed position, as well as, for forcing toggle linkage **250** upwardly to trigger cylinder **240.**

Slide **270** is actuated to commence dispensing by one of the dancer arms **81** which is pivotally mounted on pin **84** and provided with an actuator linkage **280** which rotates conjointly with the dancer arm **81** about pin **84.** Linkage **280** includes two spaced apart links **280***a* which mount a cam roller **282** therebetween by pin **283** at their ends opposite pin **84.** As dancer arm **81** is pivoted counterclockwise (as viewed in FIG. **17**), due to a demand for strap, cam roller **282** is also forced to rotate counterclockwise into engagement with a vertically disposed link **285. Link 285** extends downwardly through a cut-out **286** in cylinder **240** and piston **243** and is pivotally attached at its upper end to link **287** by means of pin **288.** Link **287** is pivotally attached to guide rail **20,** which is provided with a cut-out **20***a* to receive link **287,** by pin **289.** The surface **287***a* of link **287** abutting bearing **50** functions as a bearing surface to bear against bearing **50** so that link **287** is pivoted counterclockwise about pin **289** as the hub assembly falls from the rest position. Link **285** is freely hanging from pin **288** and as it is forced to the left under the influence of cam roller **282,** it moves within cut-out **286** and laterally bears against a roller **290** pivotally mounted at the end of slide **270** thereby causing slide **270** to move to the left.

As slide **270** moves to the left, bearing surface **270***c* causes roller **261** to ride up its inclined surface and be forced upwardly. After the center line of pin **260** has crossed the center line between pins **252** and **254,** the compression spring **242** causes the toggle linkage to be forced upwardly into the position shown in FIG. **18.** As the toggle linkage is forced upwardly, shoulder **244** of piston **243** bears against collar **235***a* of slide **235** thereby causing the slide to move to the left so that roller **236** rotates actuator arm **216** counterclockwise and thus forcing the over-center mechanism **210** inwardly against roller **60,** as illustrated in FIG. **18.**

As the hub assembly falls from its elevated position to the dispensing position and overrides the one-way clutch, bearing **50** strikes an angled surface **253***b* which is positioned in a generally horizontal orientation. The weight of the hub bearing on surface **253***b* forces linkage **250** downwardly thus causing piston **243** to slide relative to collar **235***a* be forced to the right and compress spring **242.** Thus, by allowing the reduced diameter portion **245** to slide relative to collar **235***a*, the spring-loaded piston **243** is returned to a compressed state by the falling hub. Moreover, slide **270** is returned to the right under the influence of roller **261** bearing against surface **270***c* as linkage **250** is pressed downwardly under the weight of the hub.

As the hub falls, bearing **50** bears against surface **287***a* of link **287** to cause the link to be pivoted counterclockwise and thus raised to the position shown in phantom line on FIG. **18.** In this manner, the dancer arm **81** may continue to pivot counterclockwise in response to demand for strap.

When slide **235** has been actuated to commence dispensing and cylinder **240** has been primed, it will be appreciated that slide **235** must be maintained in the actuating position since it is freely slidable and to this end a latch mechanism **300** is provided. The latch mechanism **300,** FIGS. **17** and **18,** includes a pair of pivot links **301,** FIG. **20,** which are pivotally attached to the frame by means of pin **302.** The upper ends of links **301** extend into elongated cut-outs **235***d*, in the right-hand end of slide **235** and are provided with upwardly opening U-shaped cut-outs **301***a* which encompass rollers **305** mounted in cut-outs **235***d* by means of pins **304.** Thus as slide **235** is moved to the left, links **301** will be forced to rotate counterclockwise into the position illustrated in FIG. **18.**

The lower ends of links **301** are provided with outwardly facing cam rollers **306** which are utilized to operate locking latches **310,** which maintain the slide **235** in the left position during strap dispensing. Locking latches **310** have contoured locking surfaces **311** at their lower edge and are pivotally mounted to the frame by means of pin **312** outboard each pivot link

301. Locking surfaces 311 are provided with inclined entrance ramps 311*a* on which rollers 306 may ride into locking pockets 311*b* which conform to the shape of rollers 306. Latches 310 are maintained in locking engagement with rollers 306 under their own weight or may be provided with means for biasing them counterclockwise as viewed in FIG. 18. In this manner slide 235 is maintained in the dispensing position. To terminate dispensing, the latches 310 need only be released from the locked position and springs 204 and 206 within the inner axle will engage the keys 55 with the inserts 54, operate the over-center mechanism 210 and return slide 235 to the position of FIG. 17. To this end linkage 280 is provided with two pivot levers 312′ which extend rearwardly from the pivot point of the dancer arm and are positioned beneath the leading end of latches 310 so that as the dancer arm 81 pivots downwardly in response to termination in demand for strap the pivot levers 312′ lift the latches from the locked position shown in FIG. 18 thereby allowing slide 235 to move to the right under the influence of the pressure created by springs 204 and 206. Latches 310 are provided with a semicircular cut-out 310*a* which allows the latch to be rotated upwardly and clear pin 302 during the unlocking operation. As the hub rises to an equilibrium elevation, link 287 is rotated to lower link 285 into the position shown in FIG. 17.

From the above description it will be apparent that the operation of the mechanisms shown in FIGS. 16–20 is as follows: When the dispensing hub is in the rest position at an elevated location, springs 204 and 206 bias spool 62 to the right, thus maintaining the over-center mechanism in the position shown in FIG. 19. When a demand for strap is received by the dancer arm 81, cam roller 282 forces link 285 to the left to cause slide 270 to trigger toggle linkage 250. After toggle linkage 250 has been triggered, the spring-loaded cylinder 240 forces slide 235 to the left to cause actuator arm 216 to be rotated so that actuator 211 forces spool 62 to the left in FIG. 16. As the hub is released by the keys 55, it falls vertically causing link 287 to rotate counterclockwise and lift link 285 to a clearance position, as illustrated in phantom line in FIG. 18. As slide 235 moves to the left, pivot links 301 rotate causing rollers 306 to ride on the entrance surfaces 311*a* into pockets 311*b* thus locking slide 235 in the actuated position. As the hub strikes surface 253*b*, the toggle link is forced downwardly resetting the cylinder 240 and returning slide 270 to the ready position.

Strap will be continued to be dispensed in response to demand and when demand is terminated, dancer arm 81 will pivot downwardly lifting latches 310 upwardly thereby allowing rollers 306 to roll on surfaces 311*a*. When latch 310 has been lifted, springs 204 and 206 force bearing 60 outwardly to cause the over-center mechanism to rotate. As the over-center mechanism rotates, actuator arm 216 bears against roller 236 to force slide 235 rearwardly into engagement with shoulder portion 244. As the over-center mechanism is being rotated clockwise, the keys 55 are forced outwardly into engagement with inserts 54 to terminate strap dispensing and the hub rises vertically as described above, to an elevated position, thus allowing link 287 to pivot clockwise and lower link 285 into position adjacent cam roller 282 thus presenting the mechanism in condition for repeated operation.

While the disclosed embodiment and modification teach the use of transforming the rotational energy of the coil into a vertical force for storing potential energy, it will be appreciated that other methods of energy transformation and storage, (such as, storing the energy in a spring) may also be utilized without departing from the scope of the invention.

What is claimed is:

1. A method of dispensing strap comprising: providing a coil of strap on a hub; sensing demand for strap; moving said hub from an elevated rest position to a lowered strap feeding position in response to demand for strap to accelerate said hub; and decelerating said hub and utilizing the rotational energy of said hub to raise the same from the strap feeding position to the rest position in response to termination of strap demand.

2. The method of claim 1 in which strap demand is sensed by training the strap around a dancer arm assembly.

3. The method of claim 1 in which the step of hub acceleration is performed by interposing a one-way overruning device between an axle and the hub which initiates rotation of the hub during movement from the rest position to the strap feeding position and which overruns in the strap feeding position.

4. The method of claim 1 in which the step of hub deceleration is performed by supporting the hub from a frame by a pivotally mounted, horizontally movable arm; and positively coupling said hub to said arm in response to termination of strap demand while permitting the hub to rotate about the point of mounting between said arm and said frame, whereby said hub is raised from the strap feeding position to the rest position.

5. A method for dispensing strap from a coil comprising: providing a coil of strap; positioning and supporting said coil in a rest position at an elevated horizontal plane; sensing demand for strap; permitting the coil to fall from said elevated plane to a strap feeding position to a lower plane in response to demand for strap to accelerate said coil, whereby strap is dispensed and rotational energy is developed in the coil; positively terminating rotation of the coil when strap demand is terminated; converting said rotational energy into a force directed vertically upward to cause said coil to move vertically from said lower elevation and to dissipate said rotational energy in the form of work in moving therefrom to an equilibrium elevation; and supporting of the coil at said equilibrium elevation preparatory to repetition of the method.

6. A strap dispenser comprising: frame means; a hub having a coil of strap thereon; means mounting said hub on said frame means for movement between an elevated rest position and a lowered strap feeding position; latch means for retaining said hub in said rest position; strap sensing means for releasing said latch means in response to demand for strap and enabling said hub to fall toward said strap feeding position; means for accelerating said hub in response to the falling movement thereof; said strap sensing means re-engaging said latch means in the absence of demand for strap, whereby the rotational energy of said hub lifts the same from said strap feeding position to said rest position.

7. A strap dispenser as set forth in claim 6 in which said mounting means includes independently rotatable inner and outer axles mounted coaxially of said coil, and wherein said hub accelerating means includes one-way overrunning means connecting said outer axle to

said hub; said latch means releasably coupling said inner axle to said hub.

8. A strap dispenser as set forth in claim **7** in which said inner axle is a hollow shaft, and wherein said latch means includes a connection member mounted for movement outwardly of said shaft, at least one abutment on said hub adapted to be engaged by said connection member to releasably couple said inner axle to said hub, and actuating means movable axially of said shaft for moving said connection member outwardly into engagement with said abutment.

9. A strap dispenser as set forth in claim **8** in which said connection member is mounted for movement radially of said shaft, and wherein the engagement surfaces of said connection member and said abutment are complementarily inclined, whereby a component of the weight of said hub is directed radially inwardly of said shaft when said connection member is in engagement with said abutment.

10. A strap dispenser as set forth in claim **8** wherein said connection member has an inwardly facing reaction surface thereon, and wherein said actuating means includes a reaction member engaging said reaction surface and cam means movable axially of said shaft and having a cam profile in engagement with said reaction member.

11. A strap dispenser as set forth in claim **10** in which a plurality of abutments are provided at equally circumferentially spaced positions around said hub, and wherein a pair of radially movable connection members are provided at diametrically opposed positions on said shaft, said connection members each having an inwardly facing reaction surface, there being a reaction member in engagement with each reaction surface and with a cam profile on said cam means.

12. A strap dispenser as set forth in claim **11** in which each cam profile includes a rectilinear surface having a recess therein, and wherein the reaction surfaces on said connection member are parallel with said rectilinear surfaces, said reaction members being rollers movable within said recesses to disengage said connection members and said abutments.

13. A strap dispenser as set forth in claim **11** in which said cam means includes a cam member having a cam profile on opposite sides thereof, each profile including a pair of axially spaced rectilinear surfaces each having a pair of recesses therein, and wherein the rectilinear surfaces and recesses on opposite sides of said cam member are aligned with one another.

14. A strap dispenser as set forth in claim **12** in which said cam means includes a cam member having a cam profile on opposite sides thereof, each profile including a pair of axially spaced rectilinear surfaces each having a pair of recesses therein.

15. A strap dispenser as set forth in claim **14** wherein the rectilinear surfaces and recesses on opposite sides of said cam member are aligned with one another.

16. A strap dispenser as set forth in claim **11** in which said cam profile includes a rectilinear surface having a recess therein, and wherein said reaction member is a roller movable within said recess to disengage said connection member and said abutment.

17. A strap dispenser as set forth in claim **16** in which a guide member is positioned in said shaft adjacent said cam means, said guide means having a slot therein, and wherein said roller has a follower pin positioned within said slot.

18. A strap dispenser as set forth in claim **17** in which first and second shifter elements are positioned in said shaft, each shifter element engaging one end of said cam means.

19. A strap dispenser comprising: a hub having a coil of strap thereon; axle means centrally of said coil of strap and including coaxially arranged inner and outer axles; frame means for supporting said hub and including a horizontal guideway and a vertical guideway; means mountng said hub on said frame means and including bearing means on said axle means and received in said vertical guideway to mount said hub for vertical movement relative to said frame means, said mounting means further including a first member connected to said inner axle and supported upon said horizontal guideway and a second member connected to said outer axle and supported upon said horizontal guideway, said first and second members being constrained for movement between a rest position where said bearing means is disposed at a raised position in said vertical guideway and a strap feeding position where said bearing means is disposed at a lowered position in said vertical guideway; one-way overrunning means for preventing said hub from rotating relative to said outer axle in said rest position and permitting said hub to rotate relative to said outer axle in said strap feeding position; releasable coupling means for preventing said hub from rotating relative to said inner axle in said rest position; and control means for (1) disengaging said releasable coupling means when demand for strap occurs, whereby said hub and axle means falls from said rest position to said strap feeding position, said one-way overrunning means remaining engaged during movement of said hub and axle means from said rest position to said strap feeding position to accelerate said hub, said hub overrunning said outer axle in said strap feeding position, and (2) engaging said releasable coupling means when demand for strap terminates so that the rotational energy of said hub lifts said hub and axle means from said strap feeding position to said rest position, whereupon said one-way overrunning means and said releasable coupling means cooperate to hold said hub and axle means against movement until demand for strap again occurs.

20. A strap dispenser as set forth in claim **19** in which said frame means includes a vertical guideway at opposite sides thereof, and wherein said bearing means includes bearing members at opposite ends of said inner axle.

21. A strap dispenser as set forth in claim **19** in which said first member is an arm connected at one end to said inner axle and including a roller at its opposite end supported upon said horizontal guideway, and wherein said second member is an arm connected at one end to said outer axle and including a roller at its opposite end supported upon said horizontal guideway.

22. A strap dispenser as set forth in claim **19** in which said inner axle is a hollow shaft, and wherein said releasable coupling means includes a connection member mounted for movement outwardly of said shaft, at least one abutment on said hub adapted to be engaged by said connection member to releasably couple said inner axle to said hub, and actuating means movable axially of said shaft for moving said connection member outwardly into engagement with said abutment.

23. A strap dispenser as set forth in claim **22** in which said connection member is mounted for movement radially of said shaft, and wherein the engagement

surfaces of said connection member and said abutment are complementarily inclined, whereby a component of the weight of said hub is directed radially inwardly of said shaft when said connection member is in engagement with said abutment.

24. A strap dispenser as set forth in claim **23** in which a plurality of abutments are provided at equally circumferentially spaced positions around said hub, and wherein a pair of radially movable connection members are provided at diametrically opposed positions on said shaft.

25. A strap dispenser as set forth in claim **22** in which said connection member has an inwardly facing reaction surface thereon, and wherein said actuating means includes a reaction member engaging said reaction surface and cam means movable axially of said shaft and having a cam profile in engagement with said reaction member.

26. A strap dispenser as set forth in claim **25** in which said cam profile includes a rectilinear surface having a recess therein, and wherein said reaction member is a roller movable within said recess to disengage said connection member and said abutment.

27. A strap dispenser as set forth in claim **26** in which a guide member is positioned in said shaft adjacent said cam means, said guide member having a slot therein, and wherein said roller has a follower pin positioned within said slot.

28. Apparatus for dispensing strap from a coil mounted thereon comprising: frame means including horizontal support channels adapted to support said coil from either side with its axis in a horizontal plane and vertical guide means extending downwardly from said channels and defining a vertical path; axle means including inner and outer axles rotatably mounted in coaxial relationship therebetween; support means fixedly attached to the ends of said inner and outer axles and engaging said support channels to support said axles therefrom and to move horizontally thereon; bearing means attached to said axle means and engaging said guide means thereby to confine said axle means to said vertical path; hub means for mounting said coil for conjoint rotation therewith; one-way overrunning means mounting said hub means to said outer axle, said one-way overrunning means being rotatable in the direction of coil dispensing; means for interlocking said inner axle and said hub means, whereby said hub will move downwardly relative to said vertical path and rotate in the dispensing direction to unwind said coil after said interlocking means has been disengaged, and said hub means will move upwardly relative to said vertical path and dissipate the rotational energy of said hub in moving itself to an equilibrium position when the interlocking means is engaged, and said hub will be held in said equilibrium position by the action of said interlocking means and one-way overrunning means.

29. Apparatus as set forth in claim **28** wherein said interlocking means includes keys located in said inner axle and inserts complementarily disposed from said hub, said keys and inserts being adapted to direct a component of the coils weight radially to the axle means.

30. Apparatus as set forth in claim **28** wherein said horizontal support channels form a three-sided channel opening inwardly relative to the coil mounted therebetween, said channels being formed with a lower bearing surface from which said support means are supported and an upper horizontal member adapted to confine said engaging support means in the channel as the hub moves upwardly relative to said vertical path.

31. Apparatus as set forth in claim **28** including means for securing a coil to said hub means and comprising a plurality of coil gripping members mounted for movement radially of said hub and adapted to engage said coil for conjoint movement therewith; means for moving said gripping members inwardly and outwardly; and means for simultaneously operating said moving means.

32. A method of dispensing strap from a coil of strap comprising: sensing demand for strap; applying stored energy to said coil to initiate coil rotation and to dispense strap from said coil; sensing termination of strap demand; transforming the rotational energy of the coil into storable energy; and storing said storable energy for subsequent use in initiating subsequent coil rotation.

33. A method of dispensing strap from a coil of strap comprising: positioning said coil for rotation about an axis in a horizontal plane; sensing demand for strap; applying stored energy to said coil by moving said coil from an elevated rest position to a lowered strap dispensing position to initiate coil rotation and to dispense strap from said coil; sensing termination of strap demand; transforming the rotational energy of the coil into storable energy; and storing said storable energy for subsequent use in initiating subsequent coil rotation by moving said coil from said lowered position to an elevated position.

34. The method of claim **33** in which said coil is moved to an elevated position by converting rotational energy of said coil into a vertical lifting force.

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